

FLORA VITIENSIS NOVA

VOLUME I

*. . . Me ra nanumi kina na i Taukei dina kei Viti
na duru vesi ni vanua
mataisau ka dau ni veikau
bati kadi qaqā
dau loloma ka dau veikaroni . . .*

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FLORA VITIENSIS NOVA
A NEW FLORA OF FIJI
(SPERMATOPHYTES ONLY)

^{Charles}
ALBERT C. SMITH

VOLUME I
Introduction
Gymnospermae, Families 1-6
Angiospermae: Monocotyledones, Families 7-43
(except Family 32. Orchidaceae)



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1979

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INTRODUCTION

ACKNOWLEDGMENTS

One of the most pleasant duties of any author is to express his appreciation to the organizations and individuals who have made possible the fruition of his work. And yet, in the present case, I hardly know where to begin, because so many friends, colleagues, and well-wishers have supported the efforts that have led to the present publication.

Institutions. Since it is logical first to thank the institutions where I have held staff positions during my research in Fiji and during the preliminary studies leading to *Flora Vitiensis Nova*, I am happy to acknowledge the generosity with funds and research time of the following: New York Botanical Garden, 1933–1940; Arnold Arboretum of Harvard University, 1940–1948; U.S. National Museum of Natural History of the Smithsonian Institution, 1948–1963; University of Hawaii, 1963–1970 and since then as Emeritus; University of Massachusetts, 1970–1976 and since then as Emeritus. Honorary appointments have been held, with resulting benefits, at the Bernice P. Bishop Museum, the Gray Herbarium of Harvard University, the Harold L. Lyon Arboretum of the University of Hawaii, and the Pacific Tropical Botanical Garden (where I have served as an editorial consultant since 1977). To administrators and many colleagues at these institutions I am deeply grateful.

Granting agencies. In the United States scientists may consider themselves particularly fortunate in the number of granting agencies and in their understanding of the importance of basic research. During my first field trip in Fiji (1933–1934) my work was aided by a Bishop Museum Fellowship in Yale University and also by a direct subvention from the Yale School of Forestry. My second field trip (1947–1948) was supported by a grant from the John Simon Guggenheim Memorial Foundation and also by grants from the Penrose Fund of the American Philosophical Society and the Bache Fund of the National Academy of Sciences. My subsequent trips (1953–1954, 1967, 1969) were made possible by grants from the National Science Foundation. In fact, I must particularly thank the National Science Foundation and its officials for frequent support, in the form of travel funds, assistants' wages, supplies, and equipment, to supplement aid from institutional sources during the entire period 1953–1976. Support from this U.S. Government agency, although not necessarily great in total amount, often makes possible the realization of basic research projects that otherwise could not be concluded.

Individuals. The number of individuals who have offered moral and logistic support to my Fijian project is more than I can estimate, and only a few can here be mentioned by name. Elmer D. Merrill, who first encouraged me to turn from tropical America to the Pacific as a field of research and to pursue studies of Fijian plants subsequent to the death of John Wynn Gillespie in 1932, must be mentioned first. At the Bernice P. Bishop Museum, I have received every encouragement from many staff members, including Marie C. Neal, Edwin H. Bryan, Jr., Harold St. John, and Pieter van Royen. At the Harold L. Lyon Arboretum, Director Yoneo Sagawa has been generous with the use of facilities and with aid in planning the publication of this *Flora*. My first field trip in Fiji was greatly facilitated by the in-

terest of Samuel J. Record of the Yale School of Forestry and, in Fiji, by such distinguished individuals as Sir Maynard Hedstrom and Ratu Sir Lala Sukuna, then District Commissioner of Lau. On subsequent trips Ratu Sir Lala, as Secretary for Fijian Affairs, provided many essential contacts. The Fijian research of Otto Degener in 1940-1941 was made possible by Mrs. Anne Archbold, a patroness of science whose generosity is well known to other U.S. botanists. On my second and third Fijian trips J. Maynard Hedstrom and B. E. V. Parham were among many residents who smoothed the way for expedient field work. Since 1953 I have enjoyed the constant encouragement and advice of John W. Parham, whose management of the Fiji Herbarium and whose individual contributions have made possible much of the research upon which this *Flora* is based. Mrs. M. J. van Steenis-Kruseman has kindly supplied me with certain data difficult to obtain about some of the individuals mentioned below in my discussion of botanical exploration in Fiji. For the beautiful Fijian translation of the dedication¹ printed at the beginning of this volume I am deeply appreciative to Suliana Siwatibau and some of her colleagues at the University of the South Pacific. The map reproduced as end pages in this volume was first published at the British Admiralty on July 17, 1879, from the surveys of Captain H. M. Denham, 1854-1856, and Lieutenants W. U. Moore and G. E. Richards, 1876-1882, with additions from the works of Commander C. Wilkes, U.S.N.; the edition here used incorporates minor corrections up to 1928. Throughout all my field work in Fiji, assistance has been rendered me by individuals too numerous to mention; these include many Fiji Government officials at all levels from Governor to District Commissioner, *Roko, Buli*, and *Turaga ni koro*, as well as planters and settlers who were cordial hosts and hostesses. Most of all, innumerable Fijians in many villages have advanced my research by their assistance and hospitality; they are a delightful and cooperative people who go to great length to make a stranger feel at home and to aid him in every respect.

Collaborators in the present project have been many, but I single out for special thanks those who have prepared manuscript for particular families; they are Peter F. Hunt (Orchidaceae, not completed in time to include in this first volume), Tetsuo Koyama (Cyperaceae), John W. Parham (Poaceae), Harold E. Moore, Jr. (Arecaceae), and Dan H. Nicolson (Araceae). Many other colleagues at U.S., European, Australian, and New Zealand herbaria have been helpful beyond the call of duty in sending loans and responding to inquiries; they are too many to name, but I must in particular extend my thanks to warm personal friends at the Royal Botanic Gardens, Kew, and the British Museum (Natural History), institutions that have become recurring sources of stimulation since I first visited them in 1931.

Portions of this Introduction or all of it have been read by Joseph Ewan, Charles H. Lamoureux, B. E. V. Parham, John W. Parham, Emma van Ginneken Smith, and William L. Theobald. Their comments and additions have been of the greatest value, but any errors of omission or commission are strictly attributable to me.

Publication. Having been working intermittently on this Fijian project since 1933, I may repeat the truism that only a summarizing publication can be satisfactory to a scientist. For the sponsorship and publication of this *Flora*, therefore, I ex-

¹To the Fijian people, stalwart pioneers of the land, superb woodsmen, valiant warriors, gentle and cordial hosts, this book is dedicated.

press my deep appreciation to the Pacific Tropical Botanical Garden, in particular to its Board of Trustees, President, and Director. Their understanding and financial aid make possible the production of *Flora Vitiensis Nova*.

FIJIAN ORTHOGRAPHY

Before place names and local plant names are introduced into this *Flora*, a comment on the two systems of spelling used for Fijian names and words may be useful (Derrick, 1951; J. W. Parham, 1964, 1972). The "Fijian" system, generally used for publications circulating mainly within Fiji, was devised in 1835–1837 by the first missionaries who reduced the language to writing. This system is used in most documents produced in Fiji, in local newspapers, and in Fijian dictionaries (Capell, 1968). The so-called "phonetic" system is a modern attempt to render Fijian words in English spelling. Vowels in general are given a Latin value, but a few consonantal sounds must be rendered in English as compound consonants. This system is generally used outside of Fiji and on all externally published maps of Fiji known to me, but one must admit that it is far from phonetic in the sense of technically used pronunciation symbols. The following table will elucidate:

Fijian convention	Phonetic	Examples of pronunciation	
b	mb	number.	<u>M</u> ba.
c	th (soft)	<u>th</u> at.	<u>Th</u> akaundrove.
d	nd	<u>end</u> .	<u>N</u> andala.
g	ng	<u>singer</u> .	<u>N</u> galoa.
q	ngg	<u>finger</u> .	<u>N</u> anggara.

In *Flora Vitiensis Nova* I propose to use phonetic spelling for all geographic and local plant names, the work being primarily directed to an international scientific audience. It is hoped that local users in Fiji will not be offended by this abandonment of a familiar orthography. In fact, however, only a few minutes are required to permit one to turn from "phonetic" to "Fijian" spelling or vice versa. The phonetic orthography here adopted will enable botanical users to pronounce as Mbengga the island locally spelled as "Beqa," and to pronounce as *mothemothe* a plant name locally written as *mocemoce*. As a reasonable concession in this *Flora* I propose to use the "Fijian" convention in the names of mentioned Fijians, such as the historically important King Cakobau or the plant collector Qoro. I am convinced that, after reading the above comments, every user of *Flora Vitiensis Nova* will pronounce such names correctly.

PLAN OF THE WORK

This section of my Introduction is intended to orient the reader as to the general arrangement of *Flora Vitiensis Nova*. Publication is expected to be in three volumes. This first volume includes introductory matter and taxonomic treatments of the gymnosperms and monocotyledons. The second volume is planned to include taxonomic treatments of somewhat more than half of the dicotyledons. The final volume should complete the taxonomic consideration of the dicotyledons and contain pertinent concluding material and indices.

Sequence of taxa. Botanical readers will be thoroughly familiar with the word *taxon* (plural, *taxa*), even though it became part of biological parlance only a quar-

ter century ago. Since the word is extremely convenient and will be used with great frequency in this *Flora*, I may indicate that taxonomic groups of any rank are referred to as *taxa*. (As the word has become anglicized through usage, it will not subsequently be italicized.) Taxa are concrete groups, such as the order Potamogetonales, the family Ruppiaceae, the genus *Ruppia*, the species *Ruppia maritima*, or the variety *Ruppia maritima* var. *pacifica*. On the other hand, the concepts of order, family, genus, species, and variety are *not* taxa; they are *ranks* of taxa and are abstract concepts. These basic ideas are well expressed in the *International Code of Botanical Nomenclature*, Arts. 1-3 (Stafleu et al., 1972).

In its etymology, the word taxonomy (from the Greek *taxis* + *nomos*) implies the study of orderly arrangement, and thus one might narrowly construe it as dealing with classification. Few plant taxonomists are satisfied merely to be classifiers, and most of them consider the entire fields of evolution and biogeography to be within their purview. Nevertheless, a *Flora* such as this must be construed as a practical and definitive document with limited objectives. The taxonomist knows that he must seek causal explanations in the past, and spatially in any part of the world. Thus taxonomy is ideally a scientific discipline without intellectually restricting limits of either space or time. For present purposes, however, entirely satisfactory philosophical aspects must be limited, and in the body of this *Flora* I intend to refrain from discussing the theoretical aspects of taxonomy. In these introductory comments, however, such aspects cannot entirely be avoided.

One of the first problems that faces the compiler of any *Flora* is to decide upon a sequence in which the pertinent taxa will be discussed. He may adopt an *artificial* system, which classifies organisms purely for convenience. Or he may present a *natural* system, which reflects the situation as it is believed to exist in nature, utilizing all the information available at the time. Or he may opt for a *phylogenetic* system, which presumes to classify organisms according to their evolutionary sequence; such a system attempts to reflect genetic relationships and to indicate the putative ancestry of any included taxon. The authors or compilers of *Floras* usually avoid such a decision by arranging the taxa of their concern in some existing and well known sequence. For instance, many continental European and American *Floras* routinely follow a sequence first expressed in a multivolume work published between 1889 and 1915 under the title *Die Natürlichen Pflanzenfamilien* (Engler & Prantl, 1889-1915). This has been many times summarized in comparatively compact books under the title *Syllabus der Pflanzenfamilien*, the most recent, twelfth edition, as it pertains to angiosperms, providing a particularly satisfactory framework (Melchior, 1964). In Great Britain and many other areas the preferred sequence is that proposed between 1862 and 1883 in *Genera Plantarum* (Bentham & Hooker, 1862-1883). The two major works here discussed have been modified in many respects by subsequent botanists; the impact upon them by modern evolutionary theory is such that, in the opinion of most taxonomists, neither should be slavishly followed. Among more modern systems of classifying angiosperms, that of J. Hutchinson (1973) has a limited number of adherents, although in many details it demonstrates extraordinary perception and prescience. No works dealing with plant (or at least angiosperm) classification on a worldwide scale comparable in detail to those above discussed are yet available. Perhaps the task of producing such a work is quite beyond the scope of any individual or, for that matter, of any school of

individuals, because of the sheer mass of pertinent data bearing on plant taxonomy that has now accrued from such closely related disciplines as modern morphology, anatomy, cytology, genetics, palynology, biochemistry, phenetics, ecology, and physiology.

Nevertheless, at least three recent authors have attempted to synthesize modern concepts as they pertain to the angiosperms, or flowering plants, and to suggest sequences of orders and families that reflect their views of historical evolution. These fairly concise works, by Takhtajan (1967, 1969), Cronquist (1968), and Thorne (1968, 1976), do not presume to classify taxa of a lower rank than family (or subfamily in Thorne's system), but they are extraordinarily perceptive works in their grasp of evolutionary theory and its bearing on angiosperm classification. My personal predilection is for the sequence of classes, subclasses, orders, and families suggested by Takhtajan (1969: 205-239). These remarks do not necessarily indicate that my personal views on angiosperm relationships at the familial level are in complete accord with those of Takhtajan, who, in fact, is quite ready to change details of his system as further researches dictate. No system of plant classification can be considered totally definitive, and taxonomists are the first to introduce flexibility into all their concepts, frequently to the dismay of other botanists. The sequence proposed by Thorne is not here adopted, primarily because I have become accustomed to the major groupings proposed by Takhtajan and Cronquist. It is my personal feeling that the category of superorder, utilized by both Takhtajan and Thorne, is really unnecessary; additionally, many orders and families as recognized by Thorne (and also by Cronquist) seem overly inclusive to me. But these minor matters are of little consequence in consideration of the fact that substantial agreement as to a general system of angiosperm classification is now being skillfully developed by these mentioned botanists and others.

However, the author of a *Flora* cannot produce such a work and simultaneously elaborate on his evolutionary concepts. Because Takhtajan's 1969 system, in my opinion, expresses in general a very sound and logical sequence, I propose to follow it as regards angiosperms in *Flora Vitiensis Nova* with only minor modifications. Personally I cannot agree with either Takhtajan or Cronquist in considering the subclass Alismatidae to contain the most primitive extant monocotyledons, but nevertheless I here accept the Takhtajan sequence of monocotyledonous families. My principal departure, as to angiosperms, is to place the monocotyledons ahead of the dicotyledons. This is done for a reason that has nothing to do with evolutionary philosophy, but because the family treatments contributed by five of my colleagues all deal with monocotyledonous families. Their completed work (except the treatment of Orchidaceae) is at hand and I do not wish to delay its publication; hence all the monocotyledons (except the family Orchidaceae) are treated in this first volume. On a philosophical level, in any event, I would not concede that monocotyledons were directly derived from dicotyledons even in the remote past; it would seem more logical to assume that both major classes of angiosperms evolved in a parallel manner from the same ancestral group, very likely from a genus or family of pteridosperms, and that neither preceded the other in a consequential time sequence.

Flora Vitiensis Nova will include reference to all gymnosperms and angiosperms known by me to occur in Fiji, whether indigenous, adventive, or cultivated. Inclusion of adventive and cultivated plants, to be sure, vastly complicates a *Flora*, in that

such elements often belong to genera and even families that are not indigenous. Nevertheless, most users of *Floras* wish to know what they may expect to find in the area of their interest, and in fact some adventive plants are so well established in Fiji that one cannot be certain of their status. This is especially true of certain marginal food plants or other plants associated with Fijian lore, which indeed may have been carried from other Pacific archipelagoes by aboriginal voyagers and now appear to be indigenous. Treatments of species will not be equally intensive; I propose to devote more attention to the indigenous plants than to adventives. This is partially to satisfy my own interests, since only the indigenous taxa are consequential in phytogeographic considerations, and phytogeography is always uppermost in the mind of a floristic taxonomist. Cultivated plants will be treated even more cavalierly than adventives. By no means have all the taxa cultivated in Fiji come to my attention through personal observation or the availability of herbarium vouchers. However, insofar as I am aware of the cultivation of a taxon in Fiji, I shall include some mention of it and shall usually include its name in a key.

Identification of families. A taxonomist must be very bold indeed to present a key to plant families, even to those of a restricted area. Vast experience with the floras of all parts of the world is required, and no individual taxonomist can hope to acquire this experience in the short span of a lifetime. In the present work, with considerable diffidence, I propose to offer keys to all taxa that occur in Fiji, from the major divisions of Spermatophyta to species and infraspecific taxa. These keys will be scattered through the text in appropriate places, a method of presentation perhaps less satisfactory to the reader than an assemblage of keys at the beginning of the taxonomic treatment. A similar distribution of keys (to the family level) is utilized by Cronquist (1968) and Keng (1969), whose concepts have been freely adopted, and I have not hesitated to apply their language to families included in the present work. The reader must bear in mind, however, that keys of this sort to major groupings, presuming to indicate evolutionary relationships, are often highly unsatisfactory, as sometimes they incorporate somewhat esoteric characters (e.g., characters bearing on anatomy, palynology, embryology, etc.) that are of little or no use to the field or herbarium worker. Furthermore such keys must admit to generalizations and innumerable exceptions that only extensive "double keying" would relieve. The reader who is unfamiliar with tropical plants and who really requires a key to families would be much better served by an admittedly artificial key, which might bear no direct relationship to the selected sequence of families. Fortunately such artificial keys to families are available. The most useful, in my opinion, is the remarkable key by Hutchinson (1967), which is also included in one or another stage in each of the three editions of his *The Families of Flowering Plants* (1973; ed. 3). An artificial key to the families of gymnosperms and angiosperms occurring in Java—that is to say to most tropical families—has been included in the invaluable *Flora of Java* (Backer & Bakhuizen van den Brink, 1963–1968; 1: 3–85); this key is excellently detailed, but it is not dichotomous and a reader can become hopelessly lost in it.

Botanical users of *Flora Vitiensis Nova* will already be familiar with most families occurring in the Old World tropics, and my omission of an artificial key to families will not greatly impede the usefulness of this *Flora* to them. To other users, however, I recommend the works of Hutchinson and of Backer and Bakhuizen van

den Brink mentioned above, hoping that the tables of contents to each of my volumes, together with the ultimate indices, will allow them to find the familial text of their immediate concern.

Sequence of items within each family. The families of gymnosperms and angiosperms are consecutively numbered as they appear in this *Flora*. The *International Code of Botanical Nomenclature* does not pertain to ranks of taxa higher than family, and hence the authorship of orders is inconsequential for our purposes. For each family the name is followed by that of its author and the original reference. A brief description is provided for each family, as are comments on its size and distribution, the number of included taxa occurring in Fiji, and an indication of useful taxonomic treatments if any are pertinent. A key to the genera (if more than one) to be found in Fiji is provided. All keys in this work will be indented. Although this type of key may be slightly more space-consuming than a "running" unindented key, it permits the reader to perceive natural groupings of included taxa at a glance and it allows "back-tracking." Long unindented keys appear to the present writer to be an impediment to communication.

Treatment of genera. Genera are numbered as they appear in the key. The name of the original author and the place of publication are given for each genus, followed by secondary references if these seem of consequence in a study of Fijian plants. Generic synonyms are generally listed only if they have been used in some earlier work referring to our area. A brief description of the genus is provided and its type species is listed, usually as indicated in the *Index Nominum Genericorum* (International Association for Plant Taxonomy, 1955+). The general distribution of each genus and its representation in Fiji are discussed. If fairly recent treatments of the genus are available and are pertinent to our area, they are listed. A key to the species (if more than one) occurring in Fiji is given.

Treatment of species. Species are numbered in the sequence of their listing in the key. The author and first place of publication of each binomial are followed by secondary references that may be of interest to students of our area. The listed synonyms include the basionym (if required), synonyms that have been used in any literature referring to the plants of Fiji, and misuses of other names in the Fijian literature; these last are shown by use of the word *sensu*, to indicate that the usage was not that of the original author. Frequently the literature pertaining to neighboring archipelagoes is also indicated by references to such summarizing works as those on the New Hebrides (Guillaumin, 1931-1933), Samoa (Christophersen, 1935, 1938; Yuncker, 1945), Tonga (Yuncker, 1959), Niue (Yuncker, 1943; Sykes, 1970), and the Horne and Wallis Islands (St. John & Smith, 1971). Such references, although extraneous to a strict consideration of Fijian plants, are of potential value to phytogeographers and to readers with general Pacific interests. In place of a detailed species description I propose to give only brief ecological notes, bearing upon the habit and habitat of the plant, its altitudinal range, flower colors, phenology, and items of general interest. As a rule the indigenous species have been fully described in the comparatively recent literature (which will have been cited). Descriptions of the adventive and cultivated taxa are also available through other and more comprehensive studies (to which references will generally be given). Full and detailed descriptions of species, in my opinion, are essential in the place of original publication and in monographic revisions; in *Floras* I believe them to be less im-

perative. To aid the user in identification, technical descriptions are less useful than full keys and adequate comments on relationships.

In discussing the typification of each indigenous species I propose to record considerable detail, because this important aspect of taxonomic documentation has frequently been slighted in the past. Proper nomenclatural usage depends to a large extent upon correct understanding of the nomenclatural type of each taxon. Older authors were frequently indifferent to this detail, and therefore lectotypification is often essential, if it has not already been competently proposed. Lectotypification of older species—for instance of many proposed by Linnaeus—is beset by difficulties. In general I cannot discuss the typification of Linnaean species unless I am aware of a quotable prior study. Many of these species, like those of other botanists of the late eighteenth and early nineteenth centuries, have indeed been adequately lectotypified, but the pertinent literature is often difficult for a floristic student to trace. In the matter of typification of adventive and cultivated taxa I have been less persistent than in that of indigenous taxa. For taxa which are endemic or are typified by Fijian collections I have attempted to be definitive. Types are not recited in the paragraph listing available or representative Fijian collections.

The distribution of each included species is stated in general terms, both within Fiji and (if not endemic) elsewhere. In many instances my understanding of specific distribution differs from that of other students. Discussions of such different opinions are intended to be as objective as possible; they illustrate the varied conclusions that are inevitable among taxonomists. While perhaps puzzling to a layman, differing opinions as to the parameters and distributions of organisms are welcomed by scientists, whose conclusions are inevitably colored by their past experiences and their interpretations of evolutionary and dispersive factors.

The local names and uses of plants in Fiji are of much interest to regional users of this *Flora*, as well as to students of anthropology, linguistics, medicine, agriculture, forestry, and related fields. We are fortunate that these aspects of the Fijian flora have attracted the attention of such students as Seemann (1862a, 1865–1873), B. E. V. Parham (1942), H. B. R. Parham (1943), and J. W. Parham (1964, 1972); the last of these has given valuable advice to the compiler of the most recent Fijian dictionary (Capell, 1968). I have attempted to transcribe local names in the so-called “phonetic” system, but without recourse to a truly phonetic alphabet. Capell (1968: viii) suggests some of the consonantal variation to be anticipated in various parts of Fiji. The ultimate source of our knowledge of the Fijian names and uses of plants is the Fijian people. Most collectors in their field notes have transcribed whatever names and uses seemed to them reliable; and in recording these facets of interest I have largely relied on data supplied by collectors. However, it is imperative to be aware that Fijians have a keen sense of humor and, therefore, to take certain names and information proffered by them with a degree of caution. In recording local names and plant uses, I have omitted a number that would seem more jocose than veritable.

In citing collections of specimens other than types I have been forced to make compromises, simply because many included species are represented in herbaria by a hundred or more (sometimes by more than two hundred) Fijian collections that have been studied and recorded in preliminary notes. As a general rule, if a taxon is represented by fewer than ten or fifteen Fijian collections (i.e. “numbers”), all of

them are listed. If the number of available collections is greater, I list at least one from each island represented in the available material, and at least one from each represented Province of the two major islands. As far as possible islands are listed from northwest to southeast, and on Viti Levu and Vauna Levu the Provinces are similarly listed. Localities within islands and Provinces follow the same pattern of listing when possible. Provinces are divided into a number of smaller units, each known as a *Tikina*. *Tikina* names are infrequently found on maps and are not utilized in this *Flora*, except in cases when the collector has given that information without further detail. The need for indicating herbarium depositories is eliminated by the information included in the subsequent section of this Introduction entitled "Botanical Exploration in Fiji." For the islands (or groups of islands) best known to collectors, the general sequence is as follows:

- Yasawa Group
- Mamanutha Group
- Viti Levu (Provinces: Mba, Nandronga & Navosa, Serua, Namosi, Ra, Naitasiri, Tailevu, Rewa)
- Vatulele
- Mbengga
- Kandavu (and associated islands)
- Loma-i-Viti Group (Ovalau, Moturiki, Makongai, Wakaya, Koro, Mbatiki, Nairai, Ngau)
- Vanua Levu (Provinces: Mbua, Mathuata, Thakaundrove)
- Rambi
- Taveuni (and associated islands)
- Lau Group (Moala, Matuku, Totoya; remaining Lau islands north to south)

A paragraph or two of pertinent comment will sometimes follow the citations of available or representative collections. This comment may expand upon relationships of the species, its treatment by prior authors, characteristics that may aid in its identification, etc.

Treatment of infraspecific taxa. Many species that occur in Fiji are logically divisible into smaller taxa, either subspecies, varieties, or forms (*International Code of Botanical Nomenclature*, Art. 4; Stafleu et al, 1972). In some cases these are merely mentioned, while in other cases they are treated in full in the same sequence of informational headings noted above for species. The three major infraspecific ranks of taxa have been variously interpreted by botanists, and agreement on their usage is not universal. In very general terms, *subspecies* are usually allopatric; they occupy different ranges (e.g., different archipelagoes) and ordinarily they have begun to develop isolating mechanisms, so that one may think of them as incipient species. If such populations should be brought together artificially, or by the future removal of geographic barriers, they would presumably be interfertile. Usefulness of the rank *subspecies* seems somewhat limited to many students of oceanic plants, who often prefer to recognize spatially isolated but related populations, if distinguishing morphological features are obvious, as full *species*. *Varieties* are not necessarily allopatric; they are infraspecific populations with sometimes overlapping ranges and without fully operative isolating mechanisms. As a rule, *varieties* are quite distinct in certain parts of the range of a species, but elsewhere they seem to have a questionable morphological basis. *Forms* are usually ecological in nature.

to be expected here and there within the range of a species and probably without real isolating mechanisms; they are often sporadic and are recognizable only on the basis of a single morphological character.

Personally I am reluctant to utilize the expedient of infraspecific taxa. Too often, in taxonomic work, the recognition of ranks of taxa below that of species indicates uncertainty on the part of an author. Only painstaking experimental work will indicate the degree to which, in any given case, isolating mechanisms within a specific population are effective. Nevertheless, like most taxonomists, I occasionally utilize these ranks of taxa; but in the present *Flora* I reduce their usage as much as possible.

Measurements are usually expressed in metric terminology: km. (kilometer); m. (meter); cm. (centimeter); and mm. (millimeter). The use of dm. (decimeter) seems unnecessary in botanical work. However, sea distances and island areas are so commonly expressed in terms of "miles" and "square miles" that this usage is parenthetically continued in the section of this Introduction dealing with Fijian geography.

Collaborators who have prepared the text of various monocotyledonous families are not bound by the format or opinions discussed above. Although they have kindly adhered to my general plan, their family contributions are entirely their own responsibility.

From the foregoing comments the reader, I think, will conclude that *Flora Vitiensis Nova* is primarily a botanist's *Flora*, emphasizing nomenclature, typification, and factors related to geographic distribution. It is not planned to be merely a tool to facilitate the identification of plant taxa occurring in Fiji. Nevertheless, the author and his collaborators hope that it will serve the purpose of imparting information as to what plants grow in Fiji, what they are called in scientific and local usage, how they may be recognized, and how they have been used by Fijians and other residents of the archipelago. If these purposes are advanced in some degree, the objectives of this work will have been met.

ABBREVIATIONS

To a layman consulting a *Flora* it may sometimes seem that taxonomists use an obfuscating type of shorthand in their references to authors' names, literature, nomenclature, and herbarium depositories. Abbreviations, of course, are imperative in any scientific publication; through familiarity they become obvious and, because of space restrictions, they are necessary. In all subsequent parts of this *Flora* standardized abbreviations, to this point avoided, will be used.

Literature abbreviations. ICBN: *International Code of Botanical Nomenclature*. This is a publication prepared and edited by an elected Editorial Board after each International Botanical Congress, incorporating alterations or amplifications made by the Congress. In modern times twelve such Congresses have been held, the most recent at Leningrad in 1975. The currently available edition of the ICBN is the "Seattle edition" (Stafleu et al., 1972). This edition will be followed in the present *Flora* unless and until it is replaced by a new edition. Replacement will not change the Articles and Recommendations as to their sequence or numbering, which

by tradition remain the same; references are made to Articles and Recommendations by number rather than by page.

ING: *Index Nominum Genericorum* (International Association for Plant Taxonomy, 1955 +), a card index including the validly published scientific names of all plant genera, Recent and fossil, giving full bibliographic references to places of publication and information on typification and nomenclatural status. The cards are prepared by taxonomic specialists. It is intended eventually to publish the ING, when complete, in book form.

Periodicals have been diversely abbreviated by different authors and editors, and standardization in all taxonomic publications may be an impossible (and perhaps undesirable) objective. An invaluable recent publication is *Botanico-Periodicum-Huntianum* (Lawrence et al., 1968), to be abbreviated as B-P-H. This book includes the titles of all periodicals that contain papers of botanical interest insofar as they were known to its compilers, alternative abbreviations that they noted, and a single recommended abbreviation for each. For journals not included in B-P-H, for whatever reason, a list of words and recommended abbreviations for them (pp. 1005–1047) permits a user to compose his own periodical abbreviations.

In general, *Flora Vitiensis Nova* will use the periodical abbreviations recommended by B-P-H. But in some cases these appear to me unnecessarily prolix, and then I have either composed my own abbreviation or turned to an alternative proposed by Merrill and Walker (1938, 1947), Walker (1960), van Steenis-Kruseman and Stearn (1954), or van Steenis-Kruseman (1956). Each of these works adopts excellent abbreviations. In the present *Flora* periodical abbreviations will be consistent, and it is hoped to include in the final volume a comprehensive list of those adopted.

Each periodical abbreviation (or full title if the journal is not abbreviated) will be preceded by the word “in” to distinguish it from the abbreviation of a book title, which immediately follows the author’s or editor’s name. This usage is quite apart from the nomenclatural usage of “in” as noted in ICBN, Rec. 46D.

Authors’ names are abbreviated (or not) as dictated by taxonomic custom, which is well summarized in ICBN, Rec. 46A. The titles of books have been as diversely abbreviated as those of periodicals. In general I have tried to follow traditional usage, utilizing some of the word abbreviations listed in B-P-H (pp. 1005–1047). An indispensable work listing the more important books in plant taxonomy and their dates of publication is that of Stafleu (1967). The precise date of publication of a plant name is important for purposes of nomenclatural priority, and in this respect Stafleu has brought together the results of a vast amount of bibliographic research by many scholars.

An incredibly detailed second edition of Stafleu’s (1967) *Taxonomic Literature* is now in progress (Stafleu & Cowan, 1976). This superb work, when completed, will include information about many more botanists, books, and collections than the first edition. Additionally, it will recommend an abbreviation (if required) for the name of each included author and for the name of each included book. The general coverage of the second edition will be defined by the years 1753–1940, with special emphasis on the period between 1870 and 1914. When the proposed four volumes of “TL-2” are at hand, botanists will have one of the most valuable tools of modern times. It should then become a standard for abbreviations of authors’

names and their major works, as well as providing precise dates of publication and other essential data. Volume 1 covers authors whose family names begin with A-G; we are promised that the remaining three volumes will appear at two-year intervals. *Flora Vitiensis Nova* has now progressed to a point where I cannot always revise my abbreviations and information in accord with "TL-2," but nevertheless the first volume of this will be utilized with satisfaction.

Nomenclature abbreviations. An acquaintance with the ICBN is essential to a plant taxonomist. Unless the user of a *Flora* is familiar with the specialized language of nomenclature, he may inaccurately interpret the definitions elaborated in the ICBN. To aid lay users of the present *Flora*, a list of fairly standardized abbreviations used in botanical nomenclature and brief definitions of them are here presented. A valuable aid in appreciating the ICBN is the glossary recently prepared by McVaugh et al. (1968). Stearn's *Botanical Latin* (1966) has become an essential taxonomic tool, and his list of standard abbreviations (pp. 367-372) is in general followed here. In the present list the abbreviations or words related to botanical nomenclature and most frequently encountered in floristic and monographic works (but excluding dimensional abbreviations and others universally used) are given.

auct.; non . . . : in the sense of various authors; not . . .

basionym: *basionymum*, but usually anglicized, the name-bringing or epithet-bringing synonym which is the basis of a new combination or a new name (ICBN, Art. 33).

bibl. err.: bibliographic error, such as a mistake in a volume or page number.

comb. nov.: *combinatio nova*, a new combination (ICBN, Art. 6).

descr. excl.: *descriptioe exclusa*, with the description excluded.

descr. gen.-spec.: *descriptio generico-specifica*, a combined generic and specific description (ICBN, Art. 42).

e descr.: *e* (or *ex*) *descriptioe*, from or according to the description.

emend.: *emendatus*, used before the name of an author who has changed the circumscription of a taxon without excluding its type.

err. typogr.: *errore typographico*, by a printing mistake for which the author is not responsible (ICBN, Art. 73).

et al.: *et alii* (*aliorum*), and (or of) others, sometimes used in the citation of authors' or collectors' names after the first name, if there are more than two.

ex: from, or according to; used in citation of authors' names as specified in ICBN, Rec. 46C.

excl.: *exclusus* or *excludendus*, to be excluded.

gen. nov.: *genus novum*, a new genus.

in: used nomenclaturally as specified in ICBN, Rec. 46D.

in adnot.: *in adnotatione*, in annotation, or in a note.

in litt.: *in litteris*, in correspondence.

in obs.: *in observatione*, in observation.

ined.: *ineditus*, unpublished.

loc. cit.: *loco citato*, in the place cited, i. e. in the same volume and on the same page as the immediately preceding reference.

nom. alt.: *nomen alternativum*, an alternative name (ICBN, Art. 34).

nom. cons.: *nomen conservandum*, a name of a family or genus that has been conserved by action of an International Botanical Congress, in spite of the fact that it may be contrary to one or more provisions of the Code (ICBN, Arts. 14, 15, Appendices II, III).

nom. illeg.: *nomen illegitimum*, a name that is contrary to the rules of nomenclature (ICBN, Arts. 63-68, 72).

nom. inadmis.: *nomen inadmissum*, a name having a form that does not permit it

- to enter into botanical nomenclature and to be validly published.
- nom. invalid.: *nomen invalidum*, a name not in accordance with ICBN, Arts. 32–45.
- nom. nov.: *nomen novum*, a new name substituted for an earlier name (ICBN, Arts. 7, 72).
- nom. nud.: *nomen nudum*, a name published without a description or diagnosis, not validly published in the nomenclatural sense.
- nom. provis.: *nomen provisorium*, a provisional name, not accepted by its author at the time of publication (ICBN, Art. 34).
- nom. rejic.: *nomen rejiciendum*, a name to be explicitly rejected, by special legislation, in favor of a conserved name (ICBN, Arts. 14, 15, Appendix III).
- nom. superfl.: *nomen superfluum*, a superfluous name, applied to a taxon for which another name or epithet was already available (ICBN, Art. 63).
- non al.: *non aliorum*, not of other authors.
- non indic.: *non indicatus*, not indicated by the author.
- op. cit.: *opere citato*, in the work cited in the immediately preceding reference, but not on the same page or necessarily in the same volume.
- orth. err.: an orthographic error or an unintentional misspelling (ICBN, Art. 73).
- orth. mut.: *orthographia mutata*, an altered spelling (ICBN, Art. 73).
- orth. var.: an orthographic variant or alternative spelling of the same name (ICBN, Arts. 73–75).
- p. p.: *pro parte*, used in literature citations to indicate that a taxon has been too broadly circumscribed; also used following a collector's number (or other designation) that includes two or more elements, either taxonomically or geographically.
- pro syn.: *pro synonymo*, used in citing a name originally published as a synonym (ICBN, Rec. 50A).
- protologue: a recently introduced word (ICBN, Rec. 7B) from the Greek *protos* + *logos*; everything associated with a name at its first publication.
- quoad: with respect to.
- quoad spec. vit.: *quoad specimina vitienses*, with respect to Fijian specimens.
- quoad typ.: *quoad typum*, with respect to the type.
- s. n.: *sine numero*, without a number.
- sensu lato: in a broad sense.
- sensu . . . ; non . . . nec . . . : in the opinion of . . . ; not . . . and not . . .
- sensu str.: *sensu stricto*, in a narrow sense.
- seq.: *sequens*, following.
- sine descr. lat.: *sine descriptione latino*, without a Latin description (ICBN, Art. 36).
- sp. nov.: *species nova*, a new species.
- stat. nov.: *status novus*, a new status, used when a taxon has been altered in rank but its epithet from the name in the old rank has been retained.
- typ. cons.: *typus conservandus*, a type to be conserved which is different from that of the original author (ICBN, Art. 48).
- typ. excl.: *typo excluso*, with the type excluded.
- typ. incl.: *typo incluso*, with the type included.

Italicization. In *Flora Vitiensis Nova* italics are used for:

Names of genera and of all taxa lower in rank (e. g. species, varieties). Names of taxa higher than genus in rank are not italicized.

Local names.

Collectors' names and numbers in citations of specimens. Collectors' names, however, are not ordinarily italicized in discursive portions of the text. Institutional numbers, in some herbaria stamped on their sheets in numerical sequence to serialize their holdings, are not italicized.

Titles of books and journals when used in discursive parts of the text. These,

however, are not italicized when they are listed in citations of literature or when they are abbreviated in discursive text.

The abbreviations *fig.* (figure), *pl.* (plate), and *t.* (table), with the following number (if any).

Names of ships.

The nomenclatural abbreviations and words listed above have become integral parts of taxonomic phraseology and, even though most are expressed in Latin, they are not italicized.

Otherwise, italics are used only for emphasis, as in the subsequent portion of this Introduction dealing with botanical exploration in Fiji.

Herbarium abbreviations. An essential part of taxonomic documentation is an indication of the depositories in which herbarium specimens are to be seen. The indispensable *Index Herbariorum* (Ed. 6, Holmgren & Keuken, 1974) gives pertinent details about more than 1,500 public herbaria, suggesting an abbreviation by which each may be specified. Such abbreviations are now used in practically all taxonomic publications, and the better known depositories are widely designated in this jargonistic shorthand. Throughout *Flora Vitiensis Nova* these abbreviations will be utilized. If the sixth edition of *Index Herbariorum* is not available, practically all the abbreviations used here may be found in the fifth edition (Lanjouw & Stafleu, 1964). However, for the convenience of present readers, I herewith list and explain the herbarium abbreviations used in my Introduction; probably only a few additional ones will be required in the taxonomic treatments that follow.

A: Arnold Arboretum of Harvard University

AK: Auckland Institute and Museum

AMES: Orchid Herbarium of Oakes Ames, Botanical Museum, Harvard University

B: Botanischer Garten und Botanisches Museum, Berlin-Dahlem

BH: L. H. Bailey Hortorium, Cornell University

BISH: Bernice P. Bishop Museum, Honolulu

BM: British Museum (Natural History)

BO: Herbarium Bogoriense, Bogor, Indonesia

BRI: Queensland Herbarium, Indooroopilly, Queensland

C: Botanical Museum and Herbarium, University of Copenhagen

CANU: Botany Department, University of Canterbury, Christchurch, New Zealand

CGE: Botany School, University of Cambridge

CHR: Botany Division, Department of Scientific and Industrial Research, Christchurch, New Zealand

CN: Laboratoire de Botanique, Faculté des Sciences, Caen, France

DAV: Department of Botany, University of California, Davis

E: Royal Botanic Garden, Edinburgh

F: Field Museum of Natural History, Chicago

FH: Farlow Library and Herbarium of Cryptogamic Botany, Harvard University

FI: Herbarium Universitatis Florentinae, Istituto Botanico, Firenze

G: Conservatoire et Jardin Botaniques, Genève

G-DC: Herbarium De Candolle: at G

GH: Gray Herbarium of Harvard University

GOET: Systematisch-Geobotanisches Institut, Universität Göttingen

HGB: Institut für Allgemeine Botanik, Hamburg

HLA: Harold L. Lyon Arboretum, University of Hawaii, Honolulu

IA: Department of Botany, University of Iowa, Iowa City

K: Royal Botanic Gardens, Kew

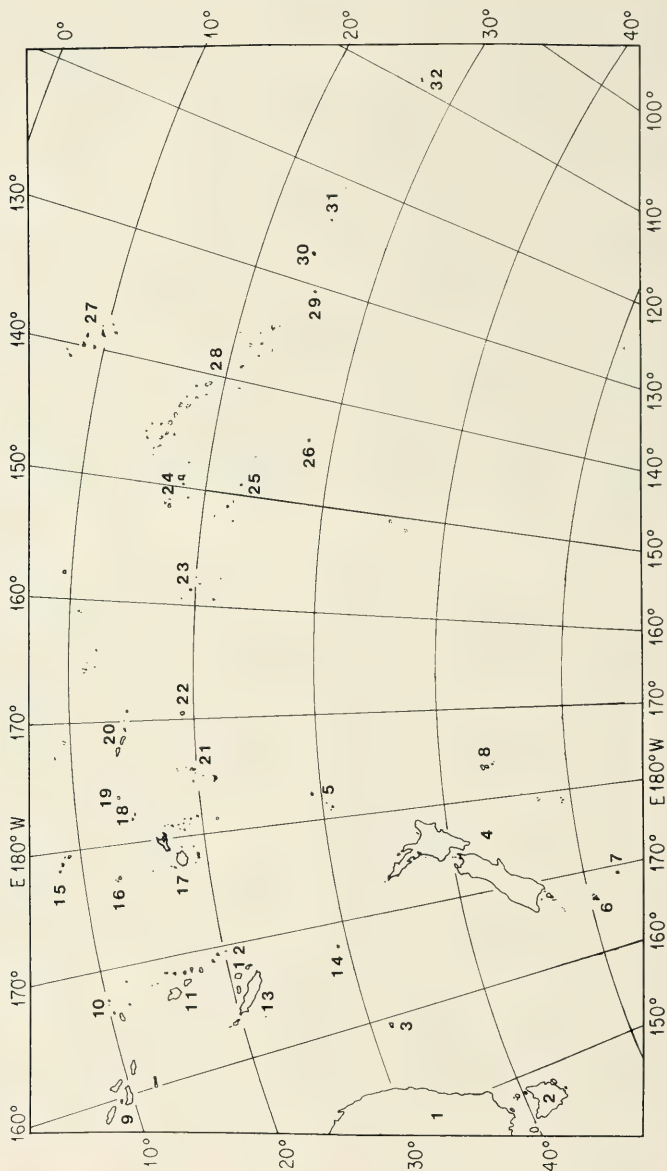
KIEL: Botanisches Institut der Universität, Kiel

KYO: Department of Botany, Kyoto University
 L: Rijksherbarium, Leiden
 LAE: Division of Botany, Department of Forests, Lae, Papua New Guinea
 LINN: The Linnean Society of London
 LIV: Merseyside County Museum, Liverpool
 MASS: Department of Botany, University of Massachusetts, Amherst
 MEL: National Herbarium of Victoria, Royal Botanic Gardens, Melbourne
 MO: Missouri Botanical Garden, St. Louis
 MW: Lomonosov State University of Moscow
 NY: New York Botanical Garden, Bronx, New York
 P: Muséum National d'Histoire Naturelle, Paris
 PH: Academy of Natural Sciences, Philadelphia
 RSA: Rancho Santa Ana Botanic Garden, Claremont, California
 S: Naturhistoriska Riksmuseet, Stockholm
 SBT: Bergius Foundation, Stockholm
 SUVA: Fiji Herbarium, Departments of Agriculture and Forestry, Suva, Fiji
 TDC: School of Botany, Trinity College, Dublin
 UC: Department of Botany, University of California, Berkeley
 UPS: Institute of Systematic Botany, University of Uppsala
 US: U.S. National Herbarium, Smithsonian Institution, Washington, D.C.
 W: Naturhistorisches Museum, Wien
 WELTU: Botany Department, Victoria University of Wellington, New Zealand
 WRSL: Museum of Natural History, Wrocław University, Poland (formerly BRSL)
 Y: Samuel James Record Memorial Collection, School of Forestry, Yale University
 Z: Botanischer Garten und Institut für Systematische Botanik der Universität Zürich

FIJIAN GEOGRAPHY

In the Deed of Cession of Fiji to Great Britain (Derrick, 1946), signed at Levuka on October 10, 1874, Fiji is defined as the group of islands in the South Pacific Ocean lying between latitudes 15° to 22° S. and longitudes 177° W. to 175° E. The area within these limits approaches 650,000 sq. km. (250,000 square miles), of which less than 3 percent is dry land. The number of islands in the archipelago, of course, depends upon one's definition of "island," "islet," "offshore rock," etc. Approximately 500 named islands and islets are listed by Derrick (1965), but many others, even the smallest, have Fijian names. The aggregate land area is approximately 18,235 sq. km. (7,040 square miles), and it may be safely estimated that no more than 100 of the islands are permanently inhabited by humans. More than half of the land area (10,388 sq. km., or 4,011 square miles) is in the island of Viti Levu, while Vanua Levu accounts for 5,535 sq. km. (2,137 square miles). Taken together, the two principal islands make up approximately 87 percent of the total land area.

Informative discussions of the geography, landscape, geology, and soils of Fiji are available in the recent publications of Derrick (1965) and Twyford and Wright (1965). In brief summary, the distinction between "high" and "low" Pacific islands, introduced by visiting seamen, is still useful. It involves the structure, appearance, and size of the islands, as well as their flora and fauna and the lives and customs of their human inhabitants. In general the islands of Fiji are "high" and of volcanic origin, but among them are many "low" islands, small, flat, and of coral formation. Still a third type is the limestone island, different from either the volcanic or the coral island.



High islands of the southern Pacific may be said to extend from New Guinea to Easter Island, nearly 11,300 km. (7,000 miles) to the east. In elevation they may approach 5,000 m., in New Guinea, but many are only a few hundred meters at their high points or even less. High elevations of the larger Fijian islands are 1,323 m. (Viti Levu), 1,032 m. (Vanua Levu), 1,241 m. (Taveuni), and 838 m. (Kandavu). The high Fijian islands have been shaped by complex forces involving volcanic action, uplift, block faulting, surface erosion, and marine erosion. The resulting land forms are diverse and often spectacular, marked by sharp volcanic plugs, ruined calderas, deep gorges and ravines carved by mountain streams, and wide, flat-bottomed valleys with impressive rivers terminating in extensive flood plains and deltas. The Rewa River and its tributaries drain about one-quarter of Viti Levu, and it has been estimated that this river discharges some 5,800 million metric tons of water into the sea each year. Dissected plains and plateaus make up a large part of the interiors of the two large islands, but they are by no means level, usually being rough, broken, and with deep valleys between ridges and mountain spurs. The Rairaimatuku Plateau in the center of Viti Levu is still comparatively undissected; it is an area of about 800 sq. km. (300 square miles), with many swamps and small lakes and bounded on the east and west by fairly steep escarpments. Limestones of different ages abundantly occur on some of the high islands, representing the remains of marine organisms deposited in thin horizontal beds when shallow seas encroached over the land. Some deposits of bedded limestone on Viti Levu are massive, up to 300 m. in height. Vanua Levu, however, has been built up entirely of volcanic products and lacks limestone formations.

Only a few of the Fijian islands may be classified as true atolls, popularly known as coral islands, but there are additionally many rings or loops of barrier reef that lack the sandy islets characteristic of atolls because they occur in relatively protected waters. It is also believed that some of the islands of Lau, such as Fulanga and Ongea, are elevated atolls, because the limestones composing them appear to be raised reefs rather than bedded limestones. Kambara also is possibly an elevated atoll.

The third type of island found in Fiji, the limestone island, is not a true elevated atoll. Although some of them show well-developed basins, their limestones do not show an elevated reef structure but instead are bedded. An example is Vatu Vara, the highest island in Lau (314 m.). From such an island the limestone has not yet been stripped to expose the underlying volcanics. On many Lau islands volcanic rocks are shown as well as limestone. These islands suggest repeated cycles of past volcanic activity, followed each time by subsidence and then uplift. After each period of uplift the land was subject to weathering and disintegration. Lau islands on which volcanic rocks have been exposed include Vanua Mbalavu, Tuvutha, Thithia, Nayau, and Oneata, among others. While such islands are not true lime-

FIGURE 1. Outline map of the southern Pacific, showing the principal archipelagoes and certain isolated islands of botanical interest. 1, Australia; 2, Tasmania; 3, Lord Howe Island; 4, New Zealand; 5, Kermadec Islands; 6, Auckland Islands; 7, Campbell Island; 8, Chatham Islands; 9, Solomon Islands; 10, Santa Cruz Islands; 11, New Hebrides; 12, Loyalty Islands; 13, New Caledonia; 14, Norfolk Island; 15, Ellice Islands; 16, Rotuma Island; 17, Fiji; 18, Horne Islands; 19, Wallis Islands; 20, Samoa; 21, Tonga; 22, Niue; 23, Cook Islands; 24, Society Islands; 25, Austral Islands; 26, Rapa Island; 27, Marquesas Islands; 28, Tuamotu Islands; 29, Pitcairn Island; 30, Henderson Island; 31, Ducie Island; 32, Easter Island.

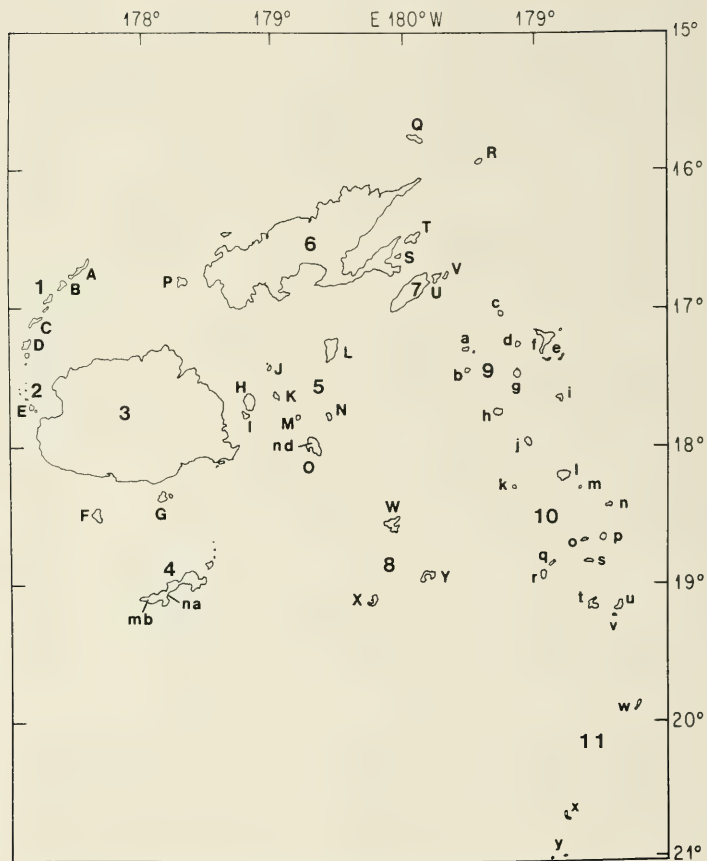


FIGURE 2. Outline map of Fiji, showing (numerals) the principal island groups and major islands and (letters) the smaller islands of botanical interest. 1, Yasawa Group; 2, Mamanutha Group; 3, Viti Levu; 4, Kandavu and associated islands; mb, Mt. Mbuke Levu, 838 m. (2,750 ft.); na, Namalata Isthmus; 5, Loma-i-Viti Group; 6, Vanua Levu; 7, Taveuni; 8, Moala Group; 9, Northern Lau Group; 10, Central Lau Group; 11, Southern Lau Group. A, Yasawa; B, Nathula; C, Naviti; D, Waya; E, Malolo; F, Vatulele; G, Mbengga; H, Ovalau; I, Moturiki; J, Makongai; K, Wakaya; L, Koro; M, Mbatiki; N, Nairai; O, Ngau; nd, Mt. Ndelaitho, 738 m. (2,420 ft.); P, Yandua; Q, Thikombia; R, Vetaua; S, Kioa; T, Rambi; U, Nggamea; V, Lauthala; W, Moala; X, Matuku; Y, Totoya; a, Yathata; b, Vatu Vara; c, Naitamba; d, Kanathea; e, Exploring Isles; f, Vanua Mbalavu; g, Mango; h, Thithia; i, Tuvutha; j, Nayau; k, Vanua Vatu; l, Lakemba; m, Aiwa; n, Oneata; o, Komo; p, Mothe; q, Wanggava; r, Kambara; s, Namuka-i-Lau; t, Fulanga; u, Ongea Levu; v, Ongea Ndriki; w, Vatoa; x, Ono-i-Lau; y, Tuvana Islands.

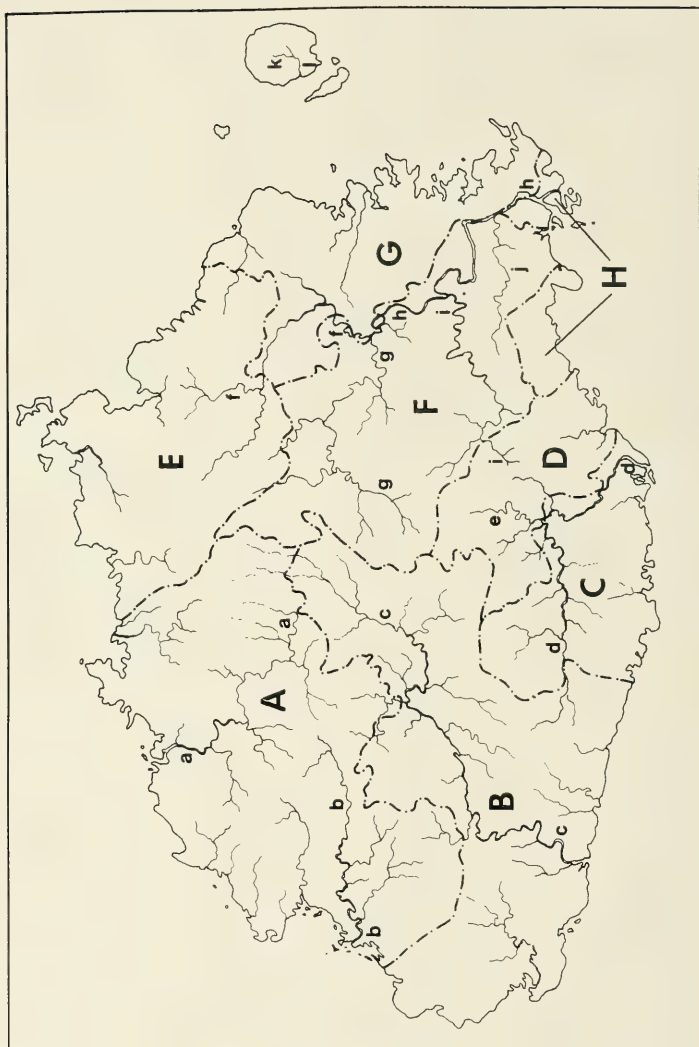
stone islands, because volcanic rocks have been exposed on them, it would seem difficult to classify them elsewhere.

Climate. The environment of any country is to a large extent controlled by its geographical position, its climate, and its physical relief. The geographical position of Fiji assures it of a mild and equable climate. The area is strongly influenced by the easterly airstream known in the southwestern Pacific as the southeast trade winds. These winds travel almost exclusively over a wide expanse of tropical ocean, becoming nearly saturated with moisture. It follows that there is a marked difference in environment on the larger islands, between the slopes and lowlands of the southern and eastern sides and those of the northern and western sides. Where the land mass is comparatively high there is a differentiation into windward and leeward types of climate. This differentiation is reflected not only in total rainfall, but in morning humidity and in mean temperature range. In general, windward localities on the large islands may be thought of as being in the "wet" zone and leeward localities as being in the "dry" zone, although there are local exceptions to such a generalization due to other factors. On the smaller "high" islands there is only a slight environmental differentiation between windward and leeward sides, and on "low" islands there is little or no such differentiation.

Between April and October the trade winds are relatively consistent; later in the year they become fitful, changing in direction more to the northeast. They become light and erratic breezes in the early morning and may die away altogether at night, to be replaced on the larger islands by a cool, offshore breeze from the interiors. Between mid-November and mid-April winds of gale or hurricane force are occasionally experienced and electrical storms are common. Strong summer winds are more common from the north or northeast and are inclined to have their greatest impact on the leeward sides. Calm periods lasting more than a few hours are comparatively rare, but periodically during the wet season the group may feel the influence of the equatorial low pressure trough. Calm periods are often broken by variable northerly winds which frequently bring heavy rain to the northern sides of the large islands.

The winter or "dry" season in Fiji, April to October, is considered the most agreeable time of year by most residents, but nevertheless during this season very unpleasant weather may be experienced. This situation comes about when an anti-cyclone in the south follows a more northerly track than usual and brings an attendant cold front to the archipelago, which may then experience squally, showery storms and stronger than usual southeasterly winds. A storm of this sort, during which a cold, wind-driven mist is continual, is locally called a *mbongiwalu* (eight nights), to be expected two or three times in each "dry" season.

It follows that the direction and duration of the trade winds in Fiji, together with physical relief, have a controlling influence on the climate and vegetation of the larger islands, causing the very definite "cool, dry" (winter) and "hot, wet" (summer) seasons. Average rainfall at various stations has been extensively documented (Derrick, 1965: 103-110; Twyford & Wright, 1965: *t. XII*) and need not be detailed here. However, it may be noted that for the wet zone of the large islands the average annual rainfall is 305-345 cm. (120-140 inches), while that of the dry zone is 165-229 cm. (65-90 inches). In the wet zone the rainfall is comparatively distributed throughout the year (e. g., at least a trace of rain is recorded in Suva on an average



of 248 days a year). In the dry zone there may be extended winter periods without rain. Average annual rainfall exceeds 500 cm. (200 inches) in many parts of the interior southeastern slopes of Viti Levu and Vanua Levu, while on the corresponding slopes of Taveuni it may approach or exceed 760 cm. (300 inches).

As to temperature, at Suva (typical for a wet zone coastal area) the average annual mean is 25° C. (77° F.), seldom above 32° C. (90° F.) or below 16° C. (60° F.). The range of monthly means is fairly constant at about 6° C. (11° F.), and the diurnal range is generally about 5.5° C. (10° F.). In the leeward, dry, coastal areas (e. g. at Lautoka and Lambasa), day temperatures above 32° C. are frequent, and night temperatures below 16° C. are occasional. The relative humidity is always high but is lower in the dry zones and during the dry season.

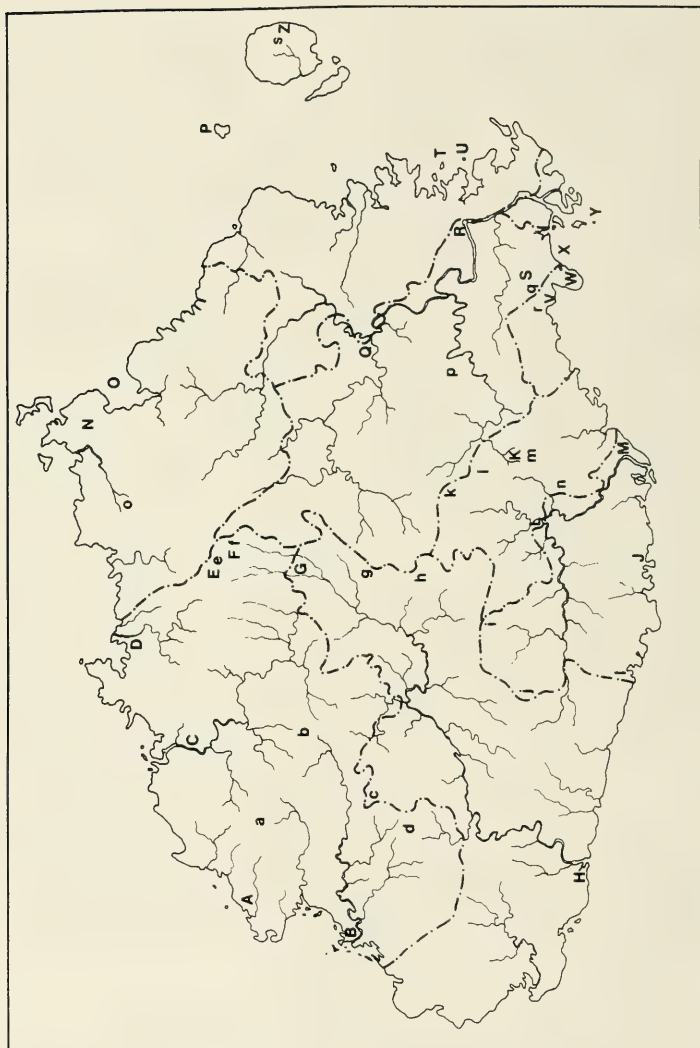
Vegetational zones. As to be expected, the vegetation of the large islands of Fiji is strikingly different in the windward and leeward areas. Four very generalized types of vegetation (J. W. Parham, 1964, 1972) may be briefly discussed: (1) coastal, (2) dry zone, (3) intermediate zone, and (4) wet zone. Mention of characteristic taxa will in general be omitted until a summary is presented in the final volume of this *Flora*.

(1) Beach vegetation is very similar, both in general aspect and in component taxa, to that found in similar environments throughout the tropical Pacific. Trees, shrubs, vines, and herbs that characterize the beach flora and that of thickets immediately behind the beaches have, with very few exceptions, facile means of dispersal and establishment. The intertidal zone, where suitable mudflats or sandy reefs occur, supports a small number (but a vast population) of interesting monocotyledons, as do the lower reaches of certain rivers. Considerable extents of mangrove forest occur near the mouths of the larger rivers and along muddy coasts; for the most part the Fijian mangrove swamps are composed of wide-ranging species.

(2) Dry zone vegetation may be said to occur on the leeward coasts of the large islands and inland up to an elevation of about 450 m. Probably the more eroded areas with comparatively sparse vegetation originally supported a light forest or a shrubby growth. Repeated burning has reduced such areas to their present condition, in which nevertheless they support a considerable variety of grasses (mostly introduced), ferns, shrubs, and small trees. The vegetation of valleys and ravines includes many trees and perhaps suggests the original cover of much of the dry zone. This type of country is known in Fiji as *talasinga* (sunburned or barren lands).

The main dividing range of Viti Levu (less a range than a broken area of considerable width) lies east of the Singatoka Valley and roughly separates the wet and dry zones; it includes at least 20 peaks higher than 900 m. Within the dry zone are large tracts of broken highlands, most notably the isolated Mt. Evans Range (culminating in Mt. Koroyanitu, 1,195 m.), the Navosa Plateau, and the Tholo West Plateau, the latter two being marked by the Naloto Range, the Nausori Highlands, and the isolated small range culminating in Mt. Koromba (alt. 1,075 m.). These

FIGURE 3. Outline map of Viti Levu and Ovalau, showing Provinces (on Viti Levu) and principal rivers; for some of the rivers both lower and upper courses are shown. Provinces: A, Mba; B, Nandronga & Navosa; C, Serua; D, Namosi; E, Ra; F, Naitasiri; G, Tailevu; H, Rewa. Rivers: a, Mba; b, Nandi; c, Singatoka; d, Navua; e, Wainikoroiuluva; f, Wainimbuka; g, Wainimala; h, Rewa; i, Wainidina; j, Waimanu; k, Lovoni; l, Mbureta.



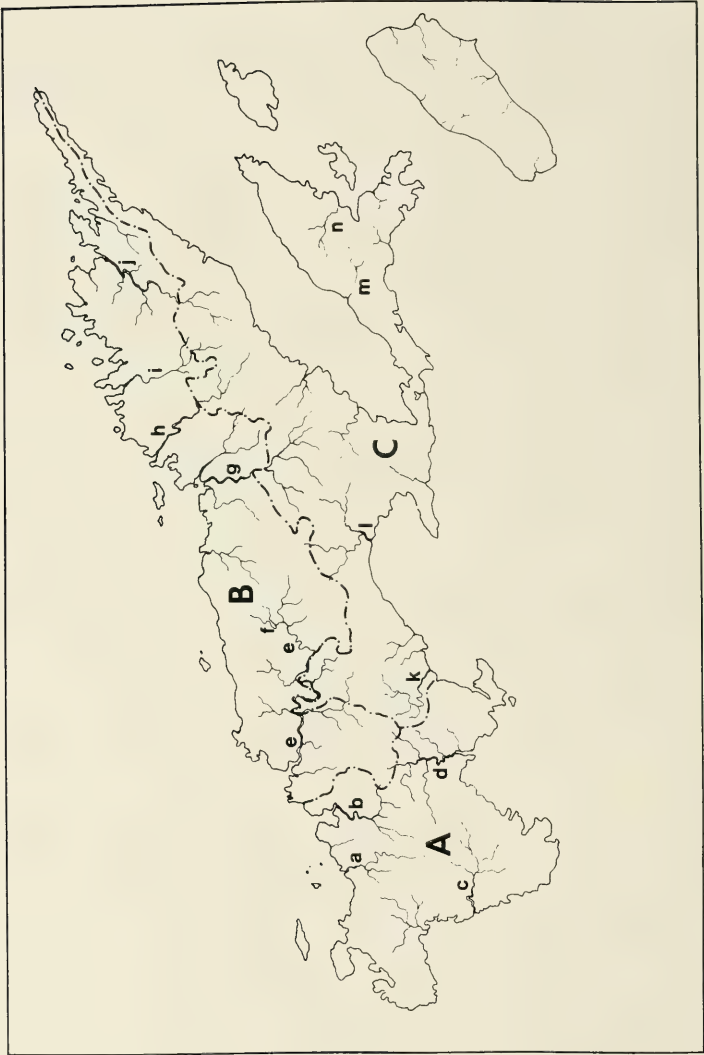
dry zone highland areas are of unusual interest, being well forested and yet more or less separated from the wet zone uplands by intervening tracts of lower dry areas, predominantly grasslands. Consequently they have been at least partially isolated from the principal forested areas of Viti Levu for a period of time, presumably not a long period in geological terms but long enough for a slight degree of taxonomic endemism to make itself apparent in some instances.

On Vanua Levu the dry zone (*talasinga*) is narrower than that of Viti Levu and lies along the northern and western coasts. It is comparatively less well demarcated from the wet zone, and it includes only minor areas high enough to catch a forest-supporting rainfall; among these areas are the interesting Mathuata (or Nawavi) Range (culminating in Mt. Mbulembulewa, 631 m.) inland from Nanduri and Mt. Numbuloa (alt. 590 m.) near Lambasa.

(3) Intermediate zone vegetation occurs in areas with rainfall better distributed than that of the dry zone but less consistent than that of the wet zone. As to be expected, the broken areas immediately leeward of the higher forested regions of the large islands support such intermediate zone vegetation. The leeward slopes in these areas are characteristically grass- and shrub-covered, while the windward slopes bear a cover of light, comparatively open forest.

(4) Wet zone vegetation, consisting principally of rain forest, is found on the windward sides of the larger islands and also on certain highlands of the leeward sides, as noted above. More than half of the land area of Fiji may be said to be forested, and of this area a large part is covered by rain forest. The Fijian lowland rain forest is characterized by having a comparatively large number of species of diverse families, without any real dominants, and it supports many lianas, creepers, and ferns. The trees include at least 50 species with a trunk girth of more than 1.5 m. The upland rain forest is inclined to support fewer species of large trees, but among them are the most important timber trees of Fiji, *Agathis vitiensis*, with a girth sometimes exceeding 6 m., and *Decussocarpus vitiensis*. Elevations in Fiji are not high enough to break the continuity of the rain forest, and certain individual species have a range extending from near sea level to the highest points. But near high points the trees are smaller, lianas fewer, and undergrowth less varied. However, epiphytes, especially orchids and ferns, conspicuously increase in number and diversity. At the highest elevations, above 1,000 m. on Viti Levu and Taveuni

FIGURE 4. Outline map of Viti Levu and Ovalau, showing places and high areas likely to be mentioned in the text. For the principal high points Fijian names are used, sometimes with mention of an English or alternative name. Places: A, Lautoka; B, Nandi; C, Mba; D, Tavua; E, Nandarivatu; F, Navai; G, Nandrau; H, Singatoka; I, Namboutini; J, Ngaloa; K, Namosi; L, Namuamua; M, Navua; N, Rewasa; O, Viti Levu Bay; P, Naingani Island; Q, Vunindawa; R, Nanduruloulou; S, Tholo-i-suva; T, Viwa Island; U, Mbau Island; V, Lami; W, Suva; X, Lauthala Bay; Y, Nukulau Island; Z, Levuka. High areas: a, Mt. Koroyanitu, high point of Mt. Evans (Thonua) Range, 1,195 m. (3,921 ft.); b, Mt. Koroimavua, high point of Naloto Range, 975 m. (3,200 ft.); c, Nausori Highlands, 745 m. (2,444 ft.); d, Mt. Koromba (Pickering Peak), 1,075 m. (3,528 ft.); e, Mt. Nanggaranambuluta (Mt. Lomalangi), 1,127 m. (3,699 ft.); f, Mt. Tomaniivi (Mt. Tomaniivi, Mt. Victoria), 1,323 m. (4,341 ft.); g, Rairaimatuku Plateau (Nandrau Plateau), 1,173 m. (3,849 ft.); h, Mt. Monavatu, 1,130 m. (3,709 ft.); i, Mt. Tikituru, 936 m. (3,071 ft.); j, Mt. Tuvutau (Mt. Gordon), 933 m. (3,060 ft.); k, Mt. Naitarandamu, 1,153 m. (3,781 ft.); l, Mt. Vuimasia, high point of Korombasambasanga Range, 1,203 m. (3,948 ft.); m, Mt. Voma (Mt. Namosi), 923 m. (3,027 ft.); n, Mt. Vakarongasiu (Mt. Nakorolo, Mt. Smythe), 860 m. (2,820 ft.); o, Mt. Ulunda, high point of Kavandra Range, 866 m. (2,840 ft.); p, Mt. Nambukelevu, high point of Mendrausuthu Range, 751 m. (2,463 ft.); q, Mt. Kombalevu, 464 m. (1,521 ft.); r, Mt. Korombamba, 429 m. (1,408 ft.); s, Mt. Ndelaivalau, 626 m. (2,053 ft.).



and 800 m. on Vanua Levu, large trees are few, but epiphytes, including bryophytes and lichens, occur in profusion. Especially on Taveuni dense tangles of *Freycinetia* cloak the sharp peaks.

Place names of botanical interest. Users of this *Flora* may be unacquainted in detail with Fijian geography, and therefore I present a series of outline maps on which are located the more important place names likely to be used in the work. To avoid congestion of names or symbols, several maps are included. FIGURE 1 is a general location map for the southern Pacific. FIGURE 2 shows the principal island groups and islands of Fiji. FIGURES 3 and 4 (Viti Levu and Ovalau) and 5 and 6 (Vanua Levu and Taveuni) show the Provinces (of the two large islands), principal rivers, selected places, and high areas. Among the places and high points shown (FIGURES 4 and 6) are several that are comparatively small or low; these are included because they are frequently mentioned by collectors and will be noted in specimen citations.

Of various maps and gazetteers, the following have been found especially useful:

(1) Appropriate Fijian maps published by the Department of Lands, Mines and Surveys, Suva.

(2) Appropriate National Ocean Survey charts published for the U.S. Department of Commerce.

(3) 1:250,000 maps of Fiji published by the Directorate of Overseas Surveys, Tolworth, Surrey, England.

(4) 1:50,000 maps of Fiji published by the Directorate of Overseas Surveys.

(5) Gazetteer (No. 7): Islands of the Central and South Pacific. Hydrographic Office Publ. no. 887, U.S. Navy Department. 1944.

(6) Douglas, G. Check list of Pacific oceanic islands. *Micronesica* 5: 327-463 (Fiji, pp. 416-432). 1969.

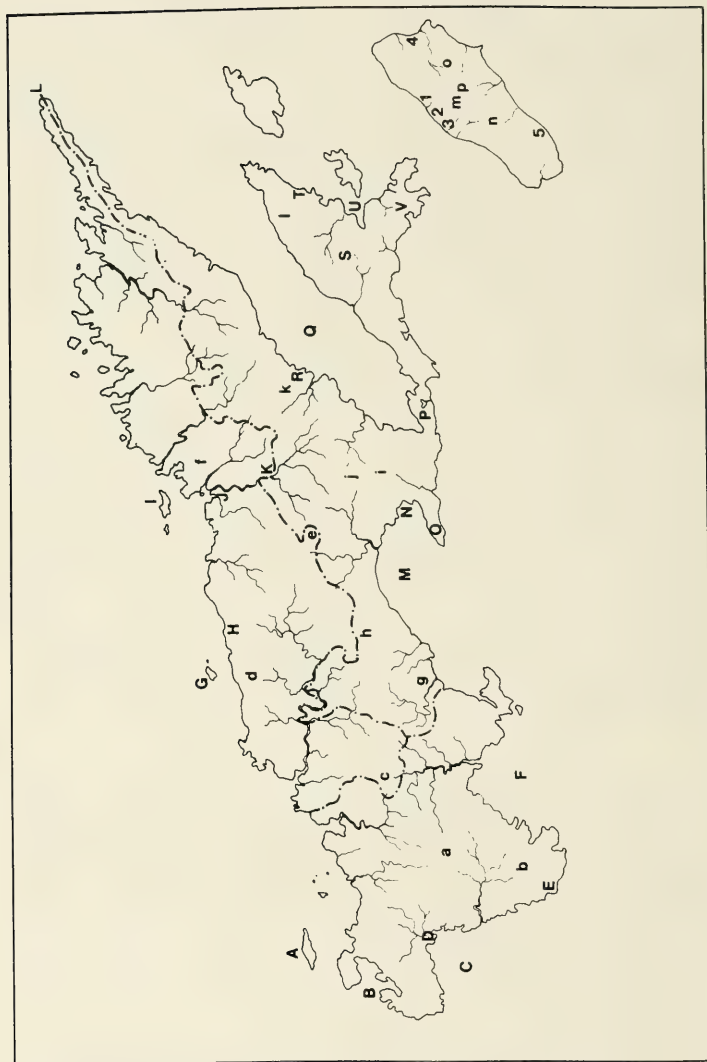
(7) Fiji, Tonga, and Nauru: Official Standard Names approved by the United States Board on Geographic Names. Department of the Interior, Washington. 1974.

The listed publications do not always agree on the spelling of place names. Usually, in case of disagreement, I adopt the spelling suggested by the U.S. Board on Geographic Names.

GEOLOGICAL BACKGROUND AND PHYTOGEOGRAPHY

An understanding of the historical phytogeography of any area has now become indissolubly linked with an appreciation of plant taxonomy (with its background data from morphology, anatomy, etc.), evolutionary theory, the paleobotanical record, and geological history. A scientific revolution of the last decade or two has resulted in nearly universal acceptance, among scientists, of the concept of plate tectonics. The idea that the earth's surface is composed of a number of moving lithospheric plates, long resisted as radical and unprovable, has suddenly become a dominating background for biologists concerned with the past movements of floras and faunas. This is not the place to expand upon the developments of a revo-

FIGURE 5. Outline map of Vanua Levu and Taveuni, showing Provinces and principal rivers on Vanua Levu. Provinces: A, Mbua; B, Mathuata; C, Thakaundrove. Rivers: a, Lekutu; b, Sarowangga; c, Ndama; d, Wainunu; e, Ndreketi; f, Korovuli; g, Lambasa; h, Mbuthaisau; i, Wainikoro; j, Nasavu; k, Yanawai; l, Nasekawa; m, Navonu; n, Mbutha.



lutionary concept in the study of the earth, but readers seeking syntheses will find historical discussions in the books of Fraser (1965) and Takeuchi et al. (1967), and more technical elaborations in the compilations edited by Wilson (1972), Bird & Isacks (1972), and Cox (1973). The extraordinary complexities of the southwestern Pacific area, in terms of its geomorphic evolution, have only comparatively recently been appreciated by students of earth history (Coleman, 1973). The triple juncture of major tectonic plates in this area has resulted in one of the most complex configurations to be found in any part of the world.

The Fijian archipelago is underlain by continental or intermediate crust, lying midway between two outward-facing arc and trench systems, the New Hebrides Arc and the Tonga Arc (Dickinson, 1967). The tectonic development of Fiji is closely related to the history of the New Hebrides and Tonga Arcs and Trenches. The extremities of this linked arc system seem to form continuous trends with deformed Tertiary and Late Mesozoic strata in New Zealand on the southeast and the Solomon Islands on the northwest. This comparatively young linked arc system lies parallel to the aligned trends of Late Paleozoic and Mesozoic strata of New Guinea, New Caledonia, and New Zealand that form a crudely concentric belt about the Australian continent as a nucleus. Although areas of deep water form bands intervening between the continent, the belt of older tectonic lands, and the younger linked arc system, these tectonic elements in the southwestern Pacific seem to be a dismembered segment of the circum-Pacific orogenic belt.

In the larger picture, it would seem that the S-shaped linked arc system composed of the New Hebrides and Tonga Arcs and Fiji forms part of the outward-facing margin of the Australian tectonic plate. This plate may be regarded (Dickinson, 1973) as the eastern portion of an Indian-Australian plate which, in its western part, has been in convergence with the Asian plate for an extended period along a complex boundary. It is generally believed that the continental crust underlying Fiji represents a slab that has drifted from closer proximity with an Australian nucleus. The bulk migration of arc-trench systems and the formation of somewhat lunate inter-arc basins behind them are features complicating the margin of the western Pacific. The true pre-Tertiary outline of the northeastern margin of the Indian-Australian plate remains to be accurately delineated, but it was probably closer to the Australian nucleus than the present outline as suggested by earthquake epicenters (Denham, 1973).

FIGURE 6. Outline map of Vanua Levu and Taveuni, showing places and high areas likely to be mentioned in the text. For the principal high points Fijian names are used, sometimes with mention of an English or alternative name. Places: A, Yangganga Island; B, Rukuruku Bay; C, Mbua Bay (Sandalwood Bay); D, Mbua; E, Nambouwalu; F, Wainunu Bay; G, Mathuata-i-wai Island; H, Nanduri; I, Mali Island; J, Lambasa; K, Nakoroutari; L, Undu Point; M, Savusavu Bay; N, Valanga Bay; O, Savusavu; P, Salt Lake; Q, Natewa Bay; R, Korotasere; S, Natewa Peninsula; T, Koroivonu; U, Mbutha Bay; V, Waikava Promontory; 1, Somosomo; 2, Waiyevo; 3, Wairiki; 4, Nggeleni; 5, Salialevu. High areas: a, Navotuvotu, high point of Mt. Seatara, 842 m. (2,764 ft.); b, Mt. Vuanda, high point of Seatovo Range, 429 m. (1,813 ft.); c, Mt. Ndelanathau, 744 m. (2,442 ft.); d, Mt. Mbulembulewa, high point of Mathuata (Nawavi) Range, 631 m. (2,070 ft.); e, Mt. Ndelaikoro, high point of Korotini Range, 941 m. (3,086 ft.); f, Mt. Numbuiloa, 590 m. (1,934 ft.); g, Mt. Kasi, 416 m. (1,365 ft.); h, Mt. Valili, 903 m. (2,966 ft.); i, Mt. Mariko (Drayton Peak), 881 m. (2,890 ft.); j, Mt. Mbatini (forming a twin peak with Mt. Soro Levu), 1,032 m. (3,386 ft.); k, Mt. Ndikeya (Mt. Thurston), 957 m. (3,139 ft.); l, Mt. Uluingala, 832 m. (2,731 ft.); m, Mt. Manuka, 842 m. (2,762 ft.); n, Mt. Uluingalau, 1,241 m. (4,072 ft.); o, Mt. Koroturanga (Des Voeux Peak), 864 m. (2,836 ft.); p, Unnamed peak (locally often confused with Mt. Koroturanga) 1.5 km. southeast of Mt. Manuka, 1,194 m. (3,920 ft.).

Although the oldest fossiliferous strata in Fiji are Early Tertiary, this fact does not preclude the possibility that the northeastern boundary of the Indian-Australian plate existed in pre-Tertiary times as a vast submarine shelf, portions of which assumed their insular character early in the Tertiary Period. Fiji has evolved during Tertiary times as a complex volcanic pile built on a segment of presumed "quasi-continental" crust (Green & Cullen, 1973), but the precise position of this crust relative to Australia during the Cretaceous remains to be ascertained.

The recent discussions of Axelrod (1970, 1975) and Raven & Axelrod (1972, 1974) are of the greatest value to biologists, especially to those concerned with Australasian paleobiology, in suggesting a possible time schedule for the northward drift of the Indian and Australian tectonic plates. Although these papers are thoroughly documented, not all paleobiologists or geophysicists agree with the stated conclusions. Raven and Axelrod are convinced that most major components of Gondwanaland remained adjacent until well into the Cretaceous Period, at least until 100 m. y. BP (million years ago), and they do not discuss the possibility that the Indian and Australian plates formed a single major unit with a definable northern and eastern boundary (Denham, 1973). They indicate that India began to drift northward only about 100 m. y. BP and collided with Asia in the Middle Eocene. Other students (Powell & Conaghan, 1973) infer that the northward-drifting Indian subcontinent converged with a proto-Tibetan landmass between the Valanginian (early Lower Cretaceous) and Maastrichtian (late Upper Cretaceous) Stages, 130 to 65 m. y. BP, and that the actual collision took place before the Middle Eocene. If this latter model is correct (and it is not directly contradicted by Axelrod, 1975: 83), the Indian plate could not have been a contiguous component of Gondwanaland 100 m. y. BP; instead, it would have left its contiguity with Africa and East Antarctica in the Jurassic Period or even earlier.

Another assumption that may require some modification is the reconstruction of Australasia in the Senonian (Upper Cretaceous, about 80 m. y. BP) suggested by Griffiths (1971) and adopted by Raven & Axelrod (1972). In this reconstruction the crustal slabs that preceded the Lord Howe Rise, Norfolk Ridge, New Zealand, New Caledonia, and the Solomon Islands were believed to be in direct contact with an Australian nucleus. However, the possibility should at least be considered that the Australian portion of the Indian-Australian plate was not that compact during its northward movement, in which case its convergence with the Asian and Pacific plates could have been earlier than sometimes believed. It has been suggested (Raven & Axelrod, 1974: 543) that the relatively direct migration of Asian plants and animals into Australasia was not feasible until mid-Miocene time, a mere 20 m. y. BP. An alternative model, suggesting the existence of a somewhat extended continental shelf north and east of an Australian nucleus, would permit such southward migration, by way of insular stepping stones on the converging Asian and Indian-Australian plates, at least by the earliest Tertiary. Indeed, if one extrapolates from the inference of Powell & Conaghan (1973), the Australian portion of the northward-moving plate may have converged with the Asian plate during the Cretaceous. Such a convergence would have preceded an early Tertiary "Melanesian Foreland" (Corner, 1975), this felicitous phrase suggesting the New Hebrides-Fiji-Tonga Ridge contemplated by Gill & Gorton (1973).

The structural, magmatic, and tectonic complexities of the western Pacific area

form a geomorphic maze; a full understanding of its geotectonic evolution is not yet at hand (Coleman, 1973). Conflicting concepts as to the history of crustal and upper mantle masses in the area remain to be clarified. Whether the formational processes were associated entirely with lateral shifts of lithospheric plates or whether vertical movements played a major role is still under consideration by geologists, geochemists, and geophysicists. At the moment, biogeographers should accept suggested temporal arrangements of western Pacific continental and subcontinental land masses with caution. This, however, is too much to expect. Speculation in advance of undisputed fact is legitimate, and no doubt desirable, in any branch of science, certainly including biogeography.

Phytogeography. The major attempts to establish demarcation lines and phytogeographic subdivisions in the Pacific are well summarized by van Balgooy (1971: 7-36), whose analysis, like that of many other botanists who have dealt with plant geography, is based only on figures derived from phanerogams. Different terminologies for units of hierarchical subdivisions complicate a comparison of such attempts, but in general there is substantial agreement among the more recent treatments. The methodologies used by different botanists in analyzing phytogeographic areas are usually based on the distribution of genera as basic working units. The fact that genera are not haphazardly distributed but are arranged in certain patterns permits meaningful analyses. Boundaries between adjacent phytogeographic areas can thus be proposed on the basis of the "distribution types spectrum" of genera for each island group. The methodology, of course, is not purely objective; it depends upon the availability of floristic and monographic studies, but since these are incomplete and uneven in reliability a substantial element of personal judgment is involved. I here compare only four recent treatments, which are well known to students of Pacific plants.

Good (1964) divides the earth's land surface into six Kingdoms, of which one, the Paletropical Kingdom, is divided into African, Indo-Malaysian, and Polynesian Subkingdoms. The last of these includes four (of a total of 37) Regions, designated as the Hawaiian Region, Region of New Caledonia, Region of Melanesia and Micronesia, and Region of Polynesia. The Region of Melanesia and Micronesia, in Good's classification, appears to include the vast area demarcated by the Bonin and Bismarck Islands on the west and the New Hebrides and Fiji on the south. Tonga and Samoa fall into his Region of Polynesia.

Thorne (1964) places Fiji, Tonga, and Samoa in his Fijian District, which together with his New Hebrides District composes a Fijian Province. This Province, a Polynesian Province, and a Hawaiian Province make up a Polynesian Subregion of his broad Oriental Region.

Takhtajan (1969) proposes a Fijian Region including the Santa Cruz Islands, the New Hebrides (and Banks Islands), Fiji, Samoa, and Tonga. This is one of 37 Regions into which he divides the earth's land surface for biogeographic purposes. The Fijian Region, Polynesian Region, and Hawaiian Region together compose a Polynesian Subkingdom, which is commensurate with his African, Madagascan, Indo-Malesian, and Neocaledonian Subkingdoms as parts of a Paletropical Kingdom, one of the six Kingdoms delimited.

In his 1971 treatment van Balgooy has chosen to divide the world's land surface into 13 unit areas, which are by no means of equal rank as to size or number of plant

genera included. The thirteenth of these unit areas, the Pacific Region, is of course the only one treated in detail; within it are discussed some 36 units, each composed of an archipelago or a single isolated island. In his hierarchical subdivision of the Pacific, van Balgooy (1971: 133, *fig. 37*) outlines an East Melanesian Province, which includes the New Hebrides (but not the Santa Cruz Islands), Fiji, Samoa, and Tonga. In turn this Province is one of four that compose an East Malesian Subregion, which together with a West Malesian Subregion makes up a Malesian Region. In his earlier treatment van Balgooy (1960) presented a somewhat more definitive map, showing a Southwest Pacific Subprovince composed of three Districts: (1) the New Hebrides (including the Santa Cruz Islands), (2) Fiji, and (3) Samoa and Tonga.

Of the authors discussed above, Thorne, Takhtajan, and van Balgooy agree in assigning the archipelagoes between the New Hebrides and Samoa to a phytogeographic unit with limits establishable by a reasonable number of discontinuities in generic distributions. To adopt Takhtajan's terminology, these archipelagoes may be said to compose a "Fijian Region." In the present *Flora* the Fijian Region will be construed as including the Santa Cruz Islands (although this archipelago is transitional toward an East Malesian or Papuan Region), the New Hebrides, Fiji, Rotuma, the Horne and Wallis Islands, Samoa, Tonga, and Niue. This area appears to have substantial phytogeographic cohesion and demonstrates a number of peripheral discontinuities.

It is of considerable interest to note that the Fijian Region, as thus defined, is geologically neither exclusively "continental" nor "oceanic" in origin. The New Hebrides (including the Santa Cruz Islands), Fiji, and Tonga are underlain by predominantly continental crust, these areas forming a tortuous frontal arc on the northeastern edge of the Indian-Australian tectonic plate. Rotuma, the Horne and Wallis Islands, Samoa, and Niue, on the other hand, are "oceanic" in the sense that they were presumably formed directly from the Pacific tectonic plate. Nevertheless, all the component archipelagoes of the Fijian Region seem to have derived their modern floras in isolation from one another and from any continental source. In effect, then, even those parts of the Fijian Region that lie within the so-called andesite line have acquired their land floras and faunas by means of long-distance dispersal. In view of the presumed origin of the land floras of each archipelago of the Fijian Region from waif immigrants, a comparison of their modern floras, when these are thoroughly known, should be illuminating in studies of dispersal mechanisms, the factors of ecology and distance, and adaptive radiation (Carlquist, 1974).

All phytogeographic conclusions in the Pacific will remain tentative until *Floras* are available for each island group, and even then uniformity of treatment will doubtless remain unattainable. One objective of the present *Flora* is to provide documentation of Fijian phanerogams that future phytogeographers may utilize, although I am well aware that students of the floras of (for instance) Malesia, the New Hebrides, and Samoa may not concur with my interpretations of the limits of genera and species.

Delimitation of taxa. Van Balgooy (1971: 38-49) presents an interesting justification of the use of the genus rather than the species as a phytogeographic working unit. In many discrete archipelagoes the number of indigenous phanerogam genera recognized has remained fairly constant for the past century, but the number of

indigenous species recognized has fluctuated wildly. While most (but definitely not all) phanerogam taxonomists agree as to the morphological parameters of a given genus, opinions as to the limits of its constituent species are (and probably will continue to be) highly subjective. Comparatively few groups of phanerogam species—at least of tropical woody species with long generations—can be satisfactorily studied experimentally and the presence or absence of true isolating mechanisms thus established. A floristic botanist often has little patience with the experimental approach to the quantification of isolating mechanisms. This situation may be deplored (and in some quarters it is definitely and vociferously deplored), but it must be obvious that few *Floras* or meaningful revisions of large woody genera would be completed if their authors insisted upon experimental proof of the parameters of the species that concern them. It may be true that better *Floras* and monographs would result from the universal adoption of experimental methodology, but the conclusions would be so sparse that phytogeographers would despair of proposing even tentative hierarchical subdivisions of the world's flora. For such reasons phytogeographers concerned with an extended area like Malesia (van Steenis, 1950) or the Pacific (van Balgooy, 1971) are well advised to base their conclusions on generic rather than putative specific distributions.

Plant taxonomists, who are predisposed to classify the components of any taxon, often classify their colleagues into “lumpers” and “splitters” as regards their use of the rank of species. A subjective element in the interpretation of this rank can scarcely be avoided, even when experimental studies indicate that different populations of a genus have not attained complete genetic isolation and hence are not “biological species;” in such cases the problem is merely transferred to a different, infraspecific level. In the last analysis, expediency may dictate to the author of a *Flora* or a monograph the rank at which he will nomenclaturally designate a certain population. Experience indicates to many plant taxonomists that excessive “lumping” at the species level causes excruciating problems to subsequent monographers, who must disentangle involved synonymies, lectotypify nomenclatural entities that have been ignored as inconsequential, and delve into meaningless distributional melanges. At the other extreme, if the prior monographer has been an extreme “splitter,” no great complications ensue as the result of a deliberate decision to combine a number of nomenclatural elements. I believe that as a rule most taxonomic monographers would prefer to follow a “splitter” rather than a “lumper.” However, a third alternative is available to the taxonomist who is alert to the problems caused by either “lumping” or “splitting;” he may examine each case on its merits and attempt to reach a decision that is both logical and expedient. He may reach this conclusion with or without the use of experimental methodology, but it need scarcely be emphasized that he must be guided by contemporary evolutionary philosophy. To be sure, every practicing taxonomist believes that he is one of the happy few who are neither “lumpers” nor “splitters.”

One of the most interesting discussions of specific and infraspecific delimitation is that of van Steenis (1957) in the introduction to one of the volumes of *Flora Malesiana*; his comprehensive essay is invaluable to students of tropical plants. But to an impartial reader (and of course every taxonomist considers himself impartial) that essay must seem slanted toward a very broad species concept. An inclination toward comprehensive species, as demonstrated in many (but not all) parts of *Flora*

Malesiana and its precursory treatments, should be examined with particular caution as it bears on a part of the world where past land connections are suspect. Malesia itself is such a region, composed of many major and minor islands carried on the colliding continental shelves of the Asian and Indian-Australian tectonic plates. If land connections among some of those islands existed from time to time, they have frequently been disrupted during the Tertiary Period. Nevertheless, the vastness of many Malesian islands and their proximity to one another have made possible frequent interchanges of plant disseminules.

The same situation does not prevail in the island groups east of the Solomons. Archipelagoes of the Fijian Region are more widely spaced than are the Malesian islands, and their component islands are comparatively small. It follows that founder populations establishing themselves in the Fijian Region must necessarily have been small and infrequent in contrast to such populations in Malesia. That the isolation of small founder populations for long periods of time leads to the acquisition of isolating mechanisms, and hence to the evolution of distinct taxa, is too widely accepted a tenet of modern evolutionary theory to be ignored in a floristic work. Plant disseminules from western Malesia have *not* flowed eastward into eastern Malesia, Melanesia, and Polynesia in an endless stream, without restriction. Except in instances involving high vagility, such disseminules have been carried in a highly erratic manner, following a general west to east direction but exposed to innumerable barriers of geography and time. It is now evident that no direct unbroken Tertiary land connections existed among the many insular areas between western Malesia and the extreme eastern edge of the Asian-Australian tectonic plate. In fact, even archipelagic proximity exceeding that of the present has probably not existed in the past, and it is possible that the entire New Hebridean area was submerged for a long period and has only comparatively recently been uplifted again. This possibility would account for the comparative impoverishment of the New Hebrides and their colonization by founder populations from both east and west (van Balgooy, 1971: 93).

Present-day water gaps in the Fijian Region between the major archipelagoes are in the nature of 400–800 km., and possible Tertiary water gaps may have exceeded 1,000 km. Therefore we might be more surprised than not to find identical species represented in the descendants of a large parent population in Malesia and those of a small, stranded, founder population in Fiji, except in those instances where easy and frequent transport of disseminules is likely. To assume that the *same* genetic constitution of two populations widely separated in space and time can indefinitely persist is to obfuscate taxonomic and phytogeographic concepts.

Hence the conclusions as to taxonomic delimitation in the present work and in *Flora Malesiana* will not be parallel (although for that matter the many authors represented in *Flora Malesiana* have not always agreed with the dictates of its first editor). I did not undertake taxonomic research in the Fijian Region, some decades ago, with any preconceived certainty that botanists like Gray and Seemann had recognized an undue number of species. Therefore I find it difficult to accept an edict like that enunciated by van Steenis (1957): "Consequently the critical, revisional work for the Flora Malesiana must consist of greatly reducing the number of species, while adding a few manifestly new ones found by recent exploration." It would seem more logical, in approaching an extended floristic study, to maintain

an open mind as to the number of species that will eventually be recognized and as to their reasonable distributional limits.

The different concepts expressed above, in reference to specific delimitation, need not be further pursued in this Introduction. In the treatments of many families and genera in the taxonomic portions of this *Flora* I shall of necessity return to the points here outlined, in order to justify a particular specific concept adopted. It is no doubt fruitless to dwell at length on such basic philosophical differences. But in some cases students of Malesian plants have disposed of species of the Fijian Region and of Polynesia in so cavalier a manner as to necessitate such preliminary remarks as these (cf. Smith, 1978).

Summary. The foregoing comments on geological history and phytogeography deal with problems of broad scope and therefore might be considered out of place in a *Flora* of Fiji. However, every taxonomic revision, whether spatially or temporally limited, fits into a larger frame that no author or compiler can ignore. Referring to the gymnosperms and angiosperms indigenous to Fiji and to be discussed in the present *Flora*, a consideration of phytogeography should of course follow and not precede presentation of the taxonomic considerations. It is my hope to prepare such a phytogeographic discussion for inclusion in the final volume, when all the indigenous taxa can be adequately tabulated and their distributions compared. Until then, the generalizations here expressed provide at least a provisional background. The speculative aspects of the background are quite apparent.

A preliminary analysis of Fijian phanerogams at the generic level (van Balgooy, 1971) shows that about 35% of the 476 indigenous genera are pantropical or at least transpacific in distribution (practically all of them occurring in Malesia), and that about 55% are limited to the Old World, all but a few of these also occurring in Malesia. The remaining 10% of the genera are either endemic, or limited to the Pacific, or have an "Australian" or "subantarctic" type of distribution. The other archipelagoes comprising van Balgooy's East Melanesian Province (essentially the Fijian Region of Takhtajan) similarly demonstrate an overwhelming floristic relationship with Malesia. There would seem no doubt that the immediate source of the great bulk of the phanerogam flora of the Fijian Region was Malesia.

The ultimate source of the floristic elements of the Fijian Region is another problem. An answer to this requires a consideration of the much larger problems of (1) the time of origin of the major taxa concerned (gymnosperms and angiosperms) in relation to tectonic plate movements, (2) the place of origin of the taxa, and (3) the directions and timing of migrational movement. Obviously these problems have no glib solutions. However, in regard to the first two of them, it should be emphasized that the time and place of origin of gymnosperms (whether or not they are considered monophyletic) are not really pertinent, since gymnosperms were essentially worldwide in distribution prior to the Cretaceous and post-Cretaceous movements of tectonic plates. Consequently the breakup of Laurasia and Gondwanaland is doubtless reflected, to a large extent, in the modern distribution of gymnosperm taxa. No similar generalization should be drawn from the modern distribution of angiosperm taxa, although phytogeographers sometimes describe the movements of angiosperm-bearing tectonic plates with all the authority of eyewitnesses.

Questions surrounding the time and place of angiosperm origin are far from

solution. Most phylogenists are cautious in such matters, although their researches based on many disciplines (Walker, 1976) increasingly support the concepts of primitiveness and monophyletic in dicotyledons suggested by Cronquist (1968), Takhtajan (1969), and Thorne (1976). There is less agreement on evolutionary trends in monocotyledons. Other botanists (e. g. Hughes, 1976) express a complete lack of confidence in phylogenetic reconstructions based on extant organisms, even though such reconstructions are firmly founded on correlations between fossil evidence and many extant character complexes. For these skeptics lines of reasoning based on cumulative circumstantial evidence (Bailey, 1949) or successive approximations (Hull, 1967) hold no promise.

Speculation based on modern familial distributions, assumed phylogenetic trends, and the very inadequate fossil record of angiosperms has led to suggestions of a southeastern Laurasian ancestry (Takhtajan, 1969; Smith, 1970, 1973; Thorne, 1976; and others) and also of an origin in West Gondwanaland (Raven & Axelrod, 1974; and others). It is possible that the geography of the mid-Cretaceous, especially as it concerns the relative positions of parts of Gondwanaland, remains to be adequately documented. In view of some of the uncertainties as to the timing of the convergence of the Indian-Australian and Asian plates, mentioned above, perhaps a noncommittal attitude is preferable to a speculative one; but certainly speculation need not be entirely divorced from science.

One aspect of plant distribution sometimes inadequately emphasized by phyto-geographers is the clearly demonstrable effectiveness of long-distance dispersal (Thorne, 1973; Carlquist, 1974). It is certainly possible for extensive areas to acquire a varied, although disharmonic, angiosperm flora over a thousand or more kilometers of salt water. In view of this feasibility, now well documented in the Pacific and elsewhere, such barriers as Wallace's Line are seen to be less consequential to angiosperms than to less vagile major taxa of organisms. For early angiosperm migrations the date of the convergence of tectonic plates is more significant than the date of their actual collision. As to the angiosperm flora of the Fijian Region, its ultimate source in an area west and north of Wallace's Line seems a reasonable hypothesis. That the angiosperm flora of all of Australasia had such a source remains at least a possibility, in consideration of its floristic affinities, its comparatively disharmonic floristic composition, and temporal tectonic plate convergence.

BOTANICAL EXPLORATION IN FIJI

An acquaintance with the plant life of Fiji by European and American scientists should probably be dated from the time that still extant specimens were obtained for study. As far as I have been able to ascertain, such specimens date from the brief visit to Fiji of the ships *Astrolabe* and *Zélée* in 1838. Certainly the first European discoverers of Fiji, Tasman in 1643, Cook in 1774, and Bligh in 1789, were too preoccupied with other matters to collect botanical vouchers (Henderson, 1933; Derrick, 1946, 1951; Burns, 1963). It must be imagined that Cook was at least curious about Fiji because of his contacts with Tongans, for many of whom at the time a trip to Fiji was a kind of "grand tour." However, a more urgent objective of the explorer was to check the discoveries of Quiros and Bougainville, about which he had

read with care in Alexander Dalrymple's *An Historical Collection of the Several Voyages and Discoveries in the South Pacific Ocean*, published in 1770-1771; as a result he was seeking Bougainville's "Aurora" or, as he called it, "Maewo" (the New Hebrides). Beaglehole (1961: xciii-xciv) states that to encounter Fiji "would have provided an explorer with ample employment," and that Cook "would have been sailing on a course much more north of west than he was" to have penetrated the archipelago.

Members of Cook's crew are believed to have been the first Europeans to have gone ashore on any Fijian island, but their landing on Vatoa, in southern Lau, on July 3, 1774, did not even result in communication with the inhabitants. Georg Forster (1777) has given us a poignant account of the brief encounter: "... [the island] appeared to be seven miles long, and had two small hills of very gentle ascent, wholly covered with woods, like the rest of the island. One end sloped into a flat point, on which we observed fine groves of coco-palms, and fruit-trees, together with houses in their shade... We hoisted a boat out, and sent the master to sound an opening between the reefs which we saw before us... Our boat was hoisted in again, and the hopes of botanizing on this island, were entirely frustrated."

The first known contact between Europeans and Fijians took place in 1791, when the crew of a tender of H. M. S. *Pandora*, searching for the *Bounty* mutineers, went ashore on one of the smaller islands, probably Matuku. In August, 1792, Bligh, then in command of H. M. S. *Providence*, came into contact with Fijians, as did Barber in April, 1794, on his small vessel the *Arthur*. These first meetings did not encourage explorers to become intimate with the inhabitants of Fiji. It was not until the heyday of the sandalwood trade in Fiji, from about 1804 to 1816 (Shineberg, 1967: 7), that traders and adventurers became acquainted with parts of the archipelago; their interests seem not to have included collecting plant specimens for scientific purposes.

However, an account of botanical explorations in Fiji must include a comment on the significance of the three voyages captained by James Cook, since many plants discovered by the Cook expeditions are now known to occur in Fiji, and since frequent reference will be made in the present work to historically important specimens obtained during those voyages. Numerous books and articles, both scientific and popular, have been written about Cook's voyages and their scientific results, but reference to publications by Cook himself (1777), Henderson (1933), Buck (1953), Merrill (1954b), Beaglehole (1955-1967, with very valuable annotations), Beddie (1970), and Grant, Fosberg, & Smith (1974) will suffice for present purposes.

Although the Society Islands and Tahiti lie far to the east of Fiji, their botanical exploration, initiated in 1769 by Joseph Banks and his company on Cook's first voyage, set in motion events leading to the present state of our knowledge of all Pacific floras. Cook was not the first European navigator to visit the Societies; he was preceded there by Samuel Wallis, commanding the *Dolphin*, in 1767, and by Louis Antoine Bougainville in 1768. Accompanying Bougainville on *La Bouteuse* was a botanist, the young Philibert Commerson, believed to have been the first European to preserve Tahitian botanical specimens. However, Commerson's collections during the few days of his stay in April, 1768, have had no scientific impact on Pacific botany comparable to those of the Cook expeditions; in fact, no such collections are

believed to be still extant (Grant, Fosberg, & Smith, 1974).

For our purposes it is not necessary further to detail Cook's travels, but since many specimens obtained during his voyages in the Societies, Tonga, and the New Hebrides are highly significant to Fijian botany, I list the individuals whose names are particularly consequential to Pacific botany because of those exploratory trips:

First voyage (August 26, 1768, to July 13, 1771; H.M.S. *Endeavour*; Tahiti reached April 13, 1769): Joseph Banks and Daniel Carl Solander (botanists), Sydney Parkinson (artist, died at sea January 27, 1771), Herman Didrich Spöring (natural historian, died at sea January 25, 1771), Alexander Buchan (artist, died in Tahiti April 17, 1769).

Second voyage (July 13, 1772, to July 29, 1775; H.M.S. *Resolution* and *Adventure*): Johann Reinhold Forster, Johann Georg Adam Forster, and Anders Sparrman (botanists), William Hodges (artist), William Anderson (surgeon, naturalist, ethnologist).

Third voyage (July 12, 1776, to October 4, 1780; H.M.S. *Resolution* and *Discovery*; Cook killed in Hawaii February 14, 1779): William Anderson (surgeon also on second voyage, died at sea August 3, 1778), David Nelson (plant collector, later with Bligh on H.M.S. *Bounty* and died in Timor June 20, 1789), John Webber (artist).

The place of deposit of the specimens obtained during the three voyages of Cook is important to taxonomists concerned with Pacific plants (Merrill, 1954b: 201-211; Groves, 1962; Carolin, 1963; Stearn, 1969; Apfelbaum, 1971). The botanical collections of the first voyage, generally annotated as "Banks & Solander," are deposited at BM, with scattered duplicates in several other herbaria. Those obtained by Anderson on the second and third voyages and by Nelson on the third are also at BM and are usually annotated with the collector's name. A number of BM specimens are merely indicated as "Capt. Cook," and these may have been actually collected by anonymous crew members on any of the three voyages.

The disposition of the plant specimens collected on the second Cook voyage by the Forsters and Sparrman is even more consequential to taxonomists, because of the nomenclatural impact of the works of J. R. & G. Forster (1775; see also St. John, 1971) and of G. Forster (1786a, 1786b; see also Merrill, 1954a). The unhappy relationships between the Forsters and Sir Joseph Banks (Merrill, 1954b) seem to have led to the erratic distribution of botanical specimens obtained during the second voyage. Between 1775 and 1777 the Forsters studied their material (and also that of the first voyage) in Banks's residence. A set of the second voyage material, perhaps essentially complete, was left with Banks and is now at BM, annotated either as "J. R. & G. Forster" or "G. Forster's Herbarium" or "Sparrman." It is reasonable to assume that the holotypes of taxa described by J. R. & G. Forster (1775) are at BM, but this is not necessarily the case for taxa described by the younger Forster alone (1786a, 1786b). After the break with Banks and the British Admiralty in 1777 (although Banks and Georg Forster were corresponding until 1780 according to Carolin, 1963), both Forsters returned to Germany in 1778, and apparently the son took with him the balance of their collections, subsequently dispersing them. Some were returned to BM through purchase at the sale in April, 1842, of A. B. Lambert's herbarium, Lambert having purchased the herbarium of P. S. Pallas; these Forster specimens are annotated "ex Herb. Pallas." Other specimens were purchased from G. Forster, probably by John Shepherd, for the Liverpool Botanic Gardens; most of

these were transferred to κ in 1885, but some still remain at LIV today. A limited number of specimens were apparently presented to Linnaeus by G. Forster, while others were acquired by Abraham Bäck and through him by the younger Linnaeus; these specimens are now either at UPS or at LINN in the J.E. Smith Herbarium. Additional duplicates of the Forster collections (Carolin, 1963) are now to be found at GOET, KIEL, MW, P, and PH (Apfelbaum, 1971). It is sometimes assumed that the holotypes of G. Forster's taxa are deposited at GOET (Holmgren & Keuken, 1974), but in fact such specimens are presumably the residue of G. Forster's herbarium after the distributions noted above and after his death (Carolin, 1963). In actuality, many of G. Forster's BM specimens bear what appear to be original annotations with the numbers and names of taxa described in the *Prodromus*; the younger Forster certainly prepared some of his notes for the *Prodromus* between 1775 and 1777, before his herbarium was fragmented; and finally he did not move to Göttingen until 1787 (St. John, 1971), after publication of the *Prodromus*. In view of these circumstances, I believe that there may be no true holotypes for G. Forster's taxa and that a lectotype should be designated for each. When a BM specimen seems a suitable choice I suggest that it be designated as the lectotype.

Another early voyage to Tahiti of botanical consequence was that led by William Bligh (August 3, 1791, to August 3, 1793) with H.M.S. *Providence* and the pilot ship *Assistant*. The party was in the Societies for three months in 1792, finally leaving Tahiti on July 18 with breadfruit plants destined for the West Indies. The botanists James Wiles and Christopher Smith obtained a number of herbarium specimens now deposited at BM.

In the following paragraphs I chronologically summarize the botanical explorations made in Fiji, insofar as these are known to me and are consequential to a study of the flora of the archipelago. This summary is more detailed than the valuable accounts by B.E.V. Parham (1953) and J.W. Parham (1964, 1972). A valuable tool in this connection is Snow's (1969) bibliography. Collectors' names and those of certain expedition leaders and other associates, which are italicized, have been commemorated in many generic and specific plant names, and the reader will not need to be reminded of this in the taxonomic portion of the present work. By use of the herbarium abbreviations recommended in *Index Herbariorum* (Holmgren & Keuken, 1974), I indicate the herbarium depositories where the more important sets of specimens of various collectors are to be found, thereby eliminating the need of such references in the subsequent taxonomic text, except as holotypes and lectotypes are concerned.

1838. Fiji was visited by *Dumont d'Urville* on his second voyage, with the corvettes *Astrolabe* and *Zélée* (Capt. Jacquinot). The expedition left Tonga on October 12 and probably entered Fijian waters about October 14, observing a number of islands until it left Fiji on October 29 (Buck, 1953). Presumably Levuka provided the principal anchorage. During the voyage of the *Astrolabe* and *Zélée*, plant collections were made by *Jacques Bernard Hombron*, *Honoré Jacquinot*, and *Élie Le Guillou*. These individuals may have been the first to make any collections of Fijian plants that are still in existence; they are deposited at P, with scattered duplicates elsewhere. Probably the Fijian specimens, which must have been very few in number, came from Ovalau. In his narrative, Le Guillou (1844) mentions having also visited

the islands of Mbau, Viwa ("Piva"), and Vanua Levu, where the ships spent 24 hours at Sandalwood (i.e. Mbua) Bay. Le Guillou spent five days in Levuka and made a brief visit to Lovoni Valley, in interior Ovalau.

Dumont d'Urville had sailed among some of the Fijian islands during his first voyage on the *Astrolabe* in 1827, but on that occasion his men went ashore only briefly in the Rewa Roads, Viti Levu, to obtain water; apparently no botanical observations were made at that time (Derrick, 1965: 22).

1840. The most notable advance in the exploration and charting of Fiji was made by the U.S. Exploring Expedition under the command of *Charles Wilkes*, whose ships included the sloops-of-war *Peacock* and *Vincennes*, the brig *Porpoise*, the schooner *Sea Gull*, the tender *Flying Fish*, and the store ship *Relief*. Leaving Tongatapu on May 4, the ships entered the Fijian group by way of Vatoa passage on May 5 and left Fijian waters about August 14 or 15, heading for Oahu. During this period of more than three months, from its base at Levuka, Ovalau, the Expedition explored many coastal areas in great detail. The chart finally produced was a remarkable achievement, although it did not pretend to relate to the interiors of the large islands. The Expedition's farthest penetration of Viti Levu was up the Rewa River slightly beyond the mouth of the Waindina. As a result of the Expedition a host of publications has become available in addition to Wilkes's (1845) exhaustive narrative; these have been discussed by Tyler (1968) and listed by him (pp. 421-427) and by Haskell (1942). Valuable sidelights as they pertain to *Asa Gray* are provided by Dupree (1959). Stanton's (1975) account indicates that the Expedition still fascinates historians.

A surveying and exploring expedition to the Pacific Ocean was first authorized by the U.S. Congress in May, 1836, although it had been discussed and agonized over for the preceding decade. Asa Gray, already favorably known as a promising botanist, was offered a post as a participant, a prospect which pleased and excited him. However, planning the expedition led to such turmoil that Gray became disillusioned and in July, 1838, accepted a professorship at the new University of Michigan. Gray's withdrawal from the expedition certainly weakened the quality of its work, and one may speculate as to the profound changes his decision made in his own career and for that matter in the whole development of botany in North America.

The individuals (Bartlett, 1940) most intimately connected with plant collecting during the "Wilkes Expedition" were *William Rich* (a political appointee as botanist, in whom Gray had a deep lack of confidence), *William Dunlop Brackenridge* (horticulturist and assistant botanist), and *Charles Pickering* (a zoologist appointed as "naturalist"). It is not possible, because of Rich's muddled handling of the plant collections, to connect these three names with particular specimens, which will be cited in the present work as "*U.S. Expl. Exped.*" It is probable that other members of the Expedition, officers and seamen as well as scientists and their colleagues, also collected plants from time to time. Names made important by their scientific contributions are those of *Alfred T. Agate* (artist), *Joseph Pitty Couthouy* (conchologist), *James Dwight Dana* (geologist and zoologist, doubtless the most outstanding of the Expedition's scientists), *Joseph Drayton* (artist), *Horatio Emmons Hale* (philologist), and *Titian Ramsay Peale* (zoologist). It will be recognized that several members of the Expedition's personnel are commemorated in the names of genera and species of plants.



FIGURE 7. (Upper) A view eastward from the Mt. Evans Range over northwestern Viti Levu, showing dry, hilly country with patches of forest above about 450 m. In the foreground is an eastern ridge of the Mt. Evans Range with the old volcanic plug, Nairosa. In the distance is the northern part of the central plateau, showing Mt. Tomanivi 55 km. away.

(Lower) A view southward from the Mt. Evans Range over the dry hills of the valleys of the Sambeto and Nandi Rivers to the forested Mt. Koromba 27 km. in the distance.

Dried plant specimens of the Expedition, which became the nucleus of the herbarium of the U.S. National Museum, numbered 9,674 (Tyler, 1968: 415). At least several hundred of these were obtained in Fiji, but a precise number is not available. Brackenridge estimated that in Fiji six hundred species had been collected and preserved (Stanton, 1975: 213). The preparation of scientific reports following the Expedition led to considerable confusion and acrimony. It became evident that Rich was incompetent to produce a creditable work on botany, and Wilkes assigned only one part of the proposed botanical report to him, distributing other parts to Pickering, Brackenridge, William Starling Sullivant, Edward Tuckerman, and John Torrey. Rich's manuscript proved so incomplete that it was rejected. Finally Asa Gray, now established at Harvard, agreed to work on the flowering plants, provided he be allowed a period of five years and an opportunity to work abroad (Dupree, 1959: 185-215). Gray's acquaintance with William Jackson Hooker, Joseph Dalton Hooker, and George Bentham proved of great significance in this important phase of Pacific botany, as did his friendship with Joseph Henry, first Secretary of the new Smithsonian Institution. Gray's studies of the Exploring Expedition plants were plagued by Wilkes's uncompromising demands, lack of publication funds, and even by a warehouse fire that destroyed 21 of the 100 official copies of his first volume. Nevertheless, that eventual publication (1854) has become a landmark in botany; it was issued as the fifteenth scientific volume of the Exploring Expedition, but it is generally cited by botanists, as it will be throughout the present *Flora*, as: A. Gray, Bot. U.S. Expl. Exped. 1; the corresponding Atlas was published in 1856. A second botanical volume, dealing with ferns and prepared by Brackenridge, was also published in 1854 as the sixteenth of the Expedition's scientific volumes. A third botanical volume, edited by Gray but actually a miscellany dealing with mosses, lichens, algae, and fungi, was not published until 1874, as the seventeenth of the Expedition's scientific volumes. Gray's second volume dealing with *Phanerogamia* was never published, but the manuscript remains in the Gray Herbarium at Harvard. Many botanical papers, with greatly shortened descriptions of Pacific and other novelties, were published by Gray between 1848 and 1874 in the first nine volumes of the *Proceedings of the American Academy of Arts and Sciences*.

Gray meticulously honored his contract with Wilkes and returned the best set of the Exploring Expedition phanerogams to the Smithsonian Institution. Because the collections were unnumbered and often hopelessly mixed by the inept Rich, a few species seem to be better represented at GH than at US. In general, however, one may safely designate the US specimens as holotypes or lectotypes. In addition to the second set retained at GH, limited numbers of plant specimens of the Expedition are to be found at K, NY, P, and doubtless elsewhere.

1840. Contemporaneous with the U.S. Exploring Expedition was the long exploratory voyage of H. M. S. *Sulphur*, commanded by *Edward Belcher* (1843, especially 2: 36-56). The *Sulphur*, after leaving Vava'u, Tonga, entered Fijian waters on May 27, 1840, passing to the north of Vatoa. The islet of Nukulau, south of Rewa Roads, Viti Levu, was then considered a good anchorage; it was reached by the *Sulphur* on May 28, but the rudder was damaged on entering and two weeks were required for repairs. During this period Belcher made a trip to the town of Rewa in a small ship's boat, but presumably he was not accompanied by either Hinds or Barclay, plant collectors of the expedition. As far as can be ascertained, all the Fijian



FIGURE 8. (Upper) The settlement of Nandarivatu, on the edge of the northern escarpment of Viti Levu, as seen from the summit of Mt. Nangaranambuluta. To the north and northwest lie the dry hills reaching toward Tavua, Mba, and the northern coast of Viti Levu.

(Lower) A small lake on the northern part of the Rairaimatuku Plateau, east of Nandrau, with dominant aquatic plants of *Limnanthemum indicum* (from Smith 5387) and *Eleocharis dulcis* (from Smith 5389).

collections made by Hinds and Barclay were obtained on the islet of Nukulau. Although Belcher was displeased when he learned that the U.S. ships *Peacock* and *Vincennes* had beaten him to Fiji (Tyler, 1968: 170). Captain Wilkes visited the *Sulphur* in Nukulau anchorage on June 15 and the two commanders spent a cordial 18 hours together. On June 16 the *Sulphur* was again free to sail and camp on Nukulau was broken. The island of Mbengga ("Banga") was briefly visited on June 17, and on the same day the *Sulphur* passed close to Kandavu ("Cantab") enroute to the New Hebrides.

Richard Brinsley Hinds (ship's surgeon) and *George Barclay* (botanical collector, formerly a gardener at Kew) prepared a limited number of excellent herbarium specimens, now deposited at BM with duplicates at κ , during the *Sulphur's* enforced stay in Nukulau anchorage. Barclay, at least, collected only on Nukulau, and his specimens at BM bear the numbers 3422-3468 (J.B. Marshall, in litt.). Hinds (1842: 670-672) published what is probably the first botanical report dealing with plants collected in Fiji, even though his comments presumably pertain only to Nukulau. In the following year Bentham's (1843) short enumeration was of interest as being the first published report containing specific citations of Fijian collections, as well as the first descriptions of a few species based on Fijian type specimens. Bentham (1844-1846) also published a more elaborate report on the botanical results of the *Sulphur* voyage; in this (pp. 179-182. 1846) the New Guinea region, taken to include Fiji, is only briefly discussed, as Bentham apparently felt it adequately covered by his 1843 paper. The 1844-1846 report is sometimes accredited to Hinds, but actually the entire work was by Bentham except for notes on itineraries by Hinds (pp. 1-5, 58-63). Barclay's (ms.) version of the *Sulphur's* voyage remains unpublished; it exists in the form of a three-volume manuscript journal deposited at BM.

1852. Captain Sir *James Everard Home*, of H.M.S. *Calliope*, spent some time in Fijian waters (Derrick, 1946) and apparently found the time to make, or to have made for him, a small collection of plants. The specimens are at BM and some are cited by Seemann in *Flora Vitiensis* (1865-1873). The localities and precise dates of Home's Fijian specimens have not been ascertained, but apparently he was attempting to reconcile warring Fijian chiefs in October, 1852, both in the vicinity of Mbua, Vanua Levu, and in the Rewa delta region, Viti Levu. Home also made plant collections on Uvea (Wallis Islands) and in New Caledonia; some of the New Caledonian specimens bear the earlier date of 1846. He had also been a peacemaker in Tonga in August, 1852; in view of the activities of the *Calliope*, it is remarkable that plant specimens survive.

1854, 1856. Among the important exploratory voyages of the period were those of H.M.S. *Herald*, under the command of Capt. *H. Mangles Denham*. Between 1852 and 1856 these voyages resulted in important contributions to our knowledge of the plants of Australia, Lord Howe Island, the New Hebrides, and other South Pacific islands. Botanical specimens from Fiji, now deposited at κ with occasional duplicates at BM and perhaps elsewhere, were obtained by *John MacGillivray* (chief naturalist) (MacGillivray, 1855)¹ and *William Grant Milne* (botanist and assistant

¹ MacGillivray's name, even on his own plant specimens, is often spelled "McGillivray" or "M'Gillivray." In citing specimens in the present work I shall accept the first of these three spellings, which is the one used in the invaluable manuscript on biographies of Australian botanists (copy in Kew Library).

naturalist) (1855). Between September 4 and November 24, 1854, MacGillivray and Milne, collecting either separately or together, visited Mbau, Ovalau, Moturiki, Wakaya, Ngau, Moala, and adjacent islands. MacGillivray left the *Herald* when it called at Sydney late in 1854, but Milne remained with the ship and again collected in Fiji in 1856 (Milne, 1857; Macdonald, 1857). On this occasion Milne had an opportunity, with other men from the *Herald*, to explore parts of the Rewa River and its tributaries on Viti Levu between August 13 and September 24. The islands of Ovalau and Makongai, and perhaps others, were subsequently visited. Locality data transcribed directly on the herbarium sheets of MacGillivray and Milne are not too legible, but the specimens are of primary importance as being the first available from parts of Viti Levu, from several islands of Loma-i-Viti, and from the Moala group. Some of the specimens serve as types of taxa subsequently described by Gray or Seemann. There appears to be no connected narrative of the 1852–1856 expedition of H. M. S. *Herald*.

1855. During 1853 and 1855 *William Henry Harvey* visited India, Australia, and Pacific archipelagoes, primarily to collect algae, prior to his appointment to the Chair of Botany at the University of Dublin in 1856. He collected plants in Fiji in 1855, visiting the islands of Lakemba (October 13), Viwa (October 17), Mbau (October 18), Vanua Levu, and perhaps others. These dates are taken from a memoir by Harvey's cousin, Lydia Fisher (1869), who included a letter discussing his visit to Fiji (pp. 308–311). The dates given above are certainly not sufficiently extended, to judge from the considerable number of Harvey's Fijian collections and from the fact that his Fijian labels suggest that collections were made between August and November. Many of his Vanua Levu collections were obtained in the vicinity of Nandi Bay in the southern part of Mbua Province. Both before this Fijian visit and subsequently he collected in Tonga. Although Harvey's original herbarium may be deposited at TCD, the BM set of his Fijian material is probably essentially complete and there are some duplicates at K and GH; this material was studied by Seemann in connection with his *Flora Vitiensis* (1865–1873).

1855. *Eugène Vieillard* seems to have collected a few Fijian specimens, which were originally deposited in the Lenormand Herbarium at CN, now transferred to P. It is probable that a very brief stop was made at Ovalau while Jean Armand Isidore Pancher and Vieillard were travelling between Tahiti and New Caledonia, where subsequently they both made extensive collections. I have not noted any allusions to Pancher specimens collected in Fiji.

1860. The name most intimately connected with our knowledge of Fijian botany is that of *Berthold Carl Seemann* (Trimen, 1872; J. W. Parham, 1968). An exceptional and energetic person, Seemann in his comparatively short life, 1825–1871, was known for many accomplishments. Born and educated in Germany, he went to England at the age of 19 and became a gardener at Kew. He served as naturalist on H. M. S. *Herald* between 1847 and 1851, making extensive plant collections in tropical America and elsewhere, and subsequently reporting the botanical results of the expedition (Seemann, 1852–1857). With his brother, W. E. G. Seemann, he founded the journal *Bonplandia* and edited it during the ten volumes of its existence, 1853–1863, continuing its thrust by starting the *Journal of Botany, British and Foreign* and editing its first nine volumes, 1863–1871.



FIGURE 9. The dry vegetation zone of the upper portion of the Singatoka Valley, showing the entrance of the valley of Nggaliwana Creek (lower right) into the main valley of the Singatoka River, slightly west of Nandrau.

But Seemann is best known for his work on the flora of Fiji and the resultant *Flora Vitiensis* (Seemann, 1865–1873), a publication so outstanding for its period as to have become, together with Gray's (1854) earlier work, the essential background for all subsequent studies of Pacific botany. The Fijian aspects of Seemann's career resulted from his selection by W.J. Hooker, then Director at Kew, to be the botanist of a British Government Mission to consider the proffered cession of Fiji. Many aspects of the Mission, led by Col. *William James Smythe*, were detailed by Seemann in delightfully informal accounts. These accounts (1862a, 1862c) permit a detailed understanding of Seemann's Fijian travels and their precise dates, a welcome alternative to the casual records of all prior plant collectors in Fiji. Seemann's assignment was to advise Col. Smythe's Mission on the native and cultivated plants of Fiji, with special reference to the suitability of the archipelago to produce such crops as cotton, sugar, tobacco, spices, indigo, timbers, etc. Although Seemann carried out his duties conscientiously and presented a highly favorable recommendation to accept the cession, his zeal and industry also permitted the assembly of an excellent series of herbarium specimens. The achievements of this remarkable man during the brief six months that he spent in Fiji now seem unbelievable. In the following paragraphs I present a concise abstract of his travels in Fiji.

Leaving England on February 12 and arriving in Sydney on April 16, Seemann at his own expense engaged a young German assistant, *Jacob Paul Storck*, then employed at the Sydney Royal Botanic Gardens. The two botanists were unable to contact Col. Smythe in Sydney as planned and proceeded independently to Fiji on the missionary vessel *John Wesley*, landing on the island of Lakemba on May 14. The same day (after collecting 50 different species!) they left for Taveuni, but adverse weather baffled their landing at Wairiki until May 22. Until June 20 Seemann made his base at Somosomo. On May 30 an ascent was made to the main ridge of Taveuni and the remarkable "lake" that occupies the old crater above Somosomo. On June 4 a very brief trip was made to Koroivonu, a village on the Natewa Peninsula of Vanua Levu.

During many of his Fijian excursions Seemann travelled on the small schooner *Paul Jones*, often in company with the British Consul, *William Thomas Pritchard*, who kindly made available as a base his home on the islet of Landoyalewa, in the anchorage of Port Kinnaird south of the island of Ovalau. (Pritchard named this spacious and well-protected harbor after the Honorable Arthur Kinnaird, who took a deep interest in Fiji at the time; as a harbor and even as a name Port Kinnaird soon fell into complete disuse.) Pritchard (1866) has written interestingly concerning his experiences in the Pacific. Leaving Somosomo on June 20, the *Paul Jones* stopped briefly on the south coast of the Natewa Peninsula, reaching Levuka, Ovalau, on June 22. After his first meeting on June 28 with Cakobau (*Thakombau*), the dominant Fijian chief, Seemann participated in many ceremonial gatherings with other chiefs, as Smythe and Pritchard conducted the business of the Mission. Between June 28 and July 4 the *Paul Jones* carried Seemann and Pritchard from Ovalau to the town of Navua (Serua Province, Viti Levu), calling at Mbau and Viwa, passing through the Rewa delta, and stopping at the offshore island of Nanggara enroute to Navua. After a brief coastal excursion a few miles to the west of the Navua River, the *Paul Jones* retraced its route to Landoyalewa. A ceremonial visit to Cakobau's headquarters, the islet of Mbau, was conducted by the official party including Seemann between July 24 and August 2. During this period Seemann made

short trips to adjacent mainland parts of Viti Levu (in the present Tailevu Province). Subsequently a similar ceremonial visit was made to the town of Rewa. Pritchard and Seemann left Rewa Roads on August 13 and sailed to Tavuki, on the island of Kandavu; attempts to ascent Mt. Mbuke Levu, the high point of Kandavu, were abandoned because of poor weather, but several parts of western Kandavu were visited before the party again reached Navua, Viti Levu, on August 19.

An ambitious inland excursion was initiated on August 21 and a large party ascended the Navua River, proceeding on foot to Namosi Village on the upper Waindina River, which served as a base between August 22 and September 2. An ascent of Mt. Voma, which Seemann erroneously considered the highest peak of Viti Levu, was made on August 24. On September 5 the *Paul Jones* left the Navua River, called briefly at the island of Mbengga, and the next morning anchored in Taulalia Bay at the northern base of Mt. Mbuke Levu, Kandavu. Pritchard and Seemann ascended Mbuke Levu the same day, September 6, with satisfaction after their two previous failures. On September 7 the party left Kandavu for Ovalau, delayed by boisterous weather until September 11, when "home" on Landoyalewa was gratefully reached.

The *Paul Jones* required a thorough refitting after its stormy passage, and apparently Seemann spent the next month on Ovalau and the adjacent island of Moturiki. Leaving Port Kinnaird on October 10, the *Paul Jones* took Pritchard and Seemann on an ambitious circumnavigation of the island of Vanua Levu, from which trip they returned only on November 2. During the circuit of Vanua Levu the schooner stopped at many anchorages. Some of the localities visited (sometimes more than once) by Seemann were Mbua (October 11), Nukumbati Island (October 12, 28), Mathuata-i-wai Island (October 14), Nanduri (October 14, 27), Namukalau (October 15), Undu Point (October 16), Rambai Island (October 17), and Waikava Harbour (October 17). Between October 18 and 20 Seemann returned to Taveuni to examine an experimental cotton plantation he had established earlier.

Seemann took his last leave of Fiji, sailing from Levuka, on November 16, and losing sight of Kandavu on November 18, although it was March 12, 1861, before he again reached England. The botanical results of his Fijian trip must be considered extraordinary, when one contemplates the vicissitudes of small schooner travel in inclement weather, the many ceremonial interruptions demanded by the nature of the Mission, and the practical demands of his assignment.

In accord with the customary procedure of the time, Seemann sorted and numbered his specimens upon his return to England. His assigned numbers (Seemann, 1861) are 1-860, but many of these "numbers" come from more than one locality; the actual number of plants represented considerably exceeds 1,000. Fortunately good field notes are usually affixed to the κ specimens, which Seemann clearly indicates as the first set (1865-1873: iv). A good duplicate set, of 594 specimens, was sold by Seemann (with Hooker's permission) to BM for 12 pounds 10 shillings (E. W. Groves, personal communication)—a bargain at fivepence per specimen. The BM specimens, although correctly numbered, usually lack locality data. An additional set, doubtless incomplete, was sent to Asa Gray by Seemann and is to be seen at GH, while many duplicates are available at P and elsewhere.

1860-1893. As noted above, the name of *Jacob Paul Storck* is closely associated with that of Seemann. During 1860 Storck, then 21 years old, sometimes accom-

panied Seemann on field trips, but he is not credited as being a co-collector; apparently he was accident-prone and often ill at that time. He remained in Fiji for the rest of his life, establishing cotton plantations and a sugar mill with mixed success. However, he retained a keen interest in botany and horticulture, sending herbarium specimens to κ from time to time. A first lot of specimens was handled by Seemann (1862b), who assigned them the numbers 866-916; these came from Ovalau and other islands of Loma-i-Viti. Later Storck specimens, comparatively few, were otherwise received at κ and were numbered in mysterious ways, if at all; they bear no locality data but may have come from the Rewa River area of Viti Levu, where Storck spent most of his remaining years.

1862, 1864. *Eduard O. Graeffe*, a Swiss zoologist, travelled for some years in the Pacific under the auspices of the Hamburg firm of Godeffroy & Sons, visiting Fiji, Samoa, Tonga, the Wallis Islands, and doubtless other areas. The Fijian material seems to have been obtained in 1862 and 1864 and comes from southern Viti Levu, Ovalau, Kandavu, Kanathea, and perhaps elsewhere, but it would seem that Graeffe spent a longer period in Samoa or perhaps revisited it as late as 1872. Presumably the first set of Graeffe's Pacific botanical collections (or at least a part of them) was sent to Ferdinand von Mueller and is deposited at MEL. Others are known to be at HBG. A number of specimens, bearing low collection numbers (1-69) and dating from 1862, were sent by Mueller to Seemann and are deposited at BM. These, which were obtained in about equal part from Uvea (Wallis Islands) and Viti Levu, formed the basis of Seemann's (1864) list. The Graeffe specimens deposited at κ were probably collected in 1864 and bear numbers usually over 1000, although some are unnumbered. Other sets are said to be at L, W, and elsewhere. Unfortunately some of Graeffe's locality data suggest mislabelling. Several specimens indicated as "Samoa" represent species otherwise known only from Fiji; one must assume that the label is at fault when no subsequent collector has obtained that particular species in Samoa.

1863-1897. *John Bates Thurston* (later Sir John Thurston) spent much of his life in Fiji, expanding an interest in economic and ornamental plants and also collecting a limited number of indigenous plants, represented by herbarium specimens at κ . Thurston, a planter, became Prime Minister in Cakobau's government and, after the cession of Fiji to Great Britain, Colonial Secretary and Governor. He established two private introduction gardens, one at "Thornbury," Suva (now the residence of J. M. Hedstrom and well maintained as a garden), and the other at "St. Helier's," Taveuni. A list of the plants he established in those gardens has been published (Thurston, 1886).

1865. A brief visit was made to Fiji by *John Gould Veitch*, of the firm so well known in England at that period for its zeal in introducing tropical plants with horticultural potential. Apparently Veitch collected in August, 1865, on Ovalau, Mbau, and Kandavu; some of his material, after cultivation in England, has been mentioned in the literature referring to Fiji, but I have noted no actual herbarium specimens prepared by him.

1868. One of the short trips of H.M.S. *Challenger*, under the command of Commodore Lambert, was accompanied by the Australian botanist *William Robert Guilfoyle*. Leaving Sydney on May 24 and returning about four months later, the *Challenger* on this occasion (Guilfoyle, 1869) called in Samoa (Tutuila and Upolu).



FIGURE 10. (Upper) An area of lowland forest in Tailevu Province, Viti Levu, as seen from the vicinity of Ndakuivuna looking southwestward across the Rewa Valley. In the center distance, about 42 km. away, is the gap where the Waindina River cuts through the hills east of Namosi Village.

(Lower) Montane vegetation covering the summit of Mt. Uluinalau, the high point of Taveuni, as seen from the island's main ridge slightly to the north.

Tonga (Vava'u), Fiji, the New Hebrides (several islands), and New Caledonia. In Fiji Guilfoyle visited Ovalau, the lower Rewa River region of Viti Levu, Mbau, and Wakaya (the residence of the U.S. Consul, Dr. *Isaac M. Brower*). Apparently he brought back to Australia a large collection of living plants, but he did not mention herbarium specimens; if any exist they are probably at MEL. In 1873 Guilfoyle succeeded Ferdinand von Mueller as Director of the Royal Botanic Gardens at Melbourne.

1868–1916. The Lau island of Vanua Mbalavu was at one time a port of entry to Fiji and was of interest to early settlers and planters because of its potential for cotton plantations. In approximately 1868 a group of planters established at the island's port the Lomaloma Botanical Gardens. In 1875 the land was made subject to an annual Government lease and received a degree of financial assistance. *T. R. S. Johnstone* was stationed at Lomaloma between 1909 and 1916; he improved the Gardens and added plants to them, but I have found no record of herbarium specimens obtained by him. Subsequently the Gardens were much neglected and have now disappeared. A few herbarium specimens of surviving introduced plants have been obtained by members of the Fiji Department of Agriculture and are deposited at SUVA. Johnstone apparently prepared a list of the trees that he introduced, but I believe that this exists as a manuscript only.

1874. H. M. S. *Challenger* continued its exploratory voyages in 1872–1876, under the command of Captain Frank Tourle Thomson and George S. Nares (Tizard et al., 1885; Hemsley, 1885; Moseley, 1892). The plant collector during this period, *Henry Nottidge Moseley*, prepared herbarium specimens with care and dispatched them to K from various ports touched at by the expedition. Leaving Tongatapu on July 22, 1874, the *Challenger* approached Vatoa on July 23 and left Fijian waters, passing Kandavu, on August 11. During the visit Moseley went ashore and had an opportunity to collect on the islands of Matuku, Kandavu, Ovalau, Mbau, and Viti Levu in the Rewa River area; he visited Jacob Storck at his home called "Viti," about 56 km. from the river's mouth. In addition to Moseley's Fijian specimens at K, a few duplicates are available at BM.

1875. During the extended exploring expedition of S. M. S. *Gazelle*, 1874–1876, under the command of von Schleinitz, a visit was made to Fiji and botanical specimens were obtained by the collector *Friedrich Carl Naumann*. A report on the phanerogams was published by Engler (1886), from which one may conclude that Naumann's material came from the islands of Viti Levu and Matuku and was probably obtained between October and December, 1875. It is probable that herbarium collections were deposited at B and are no longer available.

1877–1878. One of the most remarkable individuals to collect herbarium material in Fiji was *John Horne*, Director of the Botanic Gardens in Mauritius, who was invited by Sir *Arthur H. Gordon*, then Governor of Fiji, to report on the forest resources of the archipelago. His report is in the form of a book (Horne, 1881) of which chapters are devoted to general aspects of the flora, food plants, ornamentals, timbers, agricultural products, and local conditions; appendices deal in detail with rubber-yielding plants, sandalwood, proposals for forest management, meteorological data, and a list of plants collected. The book includes a map showing Horne's routes in Fiji, from which one perceives that he pursued his objectives with indefatigable zeal. Only the first chapter (Horne, 1881: 3–57) details these travels,



FIGURE 11. (Upper) Waikama Bay on the west coast of Ngau, as seen from the north; this bay lies slightly south of the anchorage of H. M. S. *Herald*, from which MacGillivray and Milne collected on Ngau.

(Lower) The heavily forested eastern slopes of Mt. Ndelaitho, the high point of Ngau.

but from this account and the map it is possible to identify Horne's localities with reasonable accuracy. One detail is lacking from the travel chapter: not a single date is mentioned. From notations on his specimens I find that Horne was collecting at least between December, 1877 (on Ovalau, the first island visited), and September, 1878 (on Taveuni, toward the end of his visit). Specimens are numbered up to about 1150, but many lack numbers, probably through no fault of Horne. His field labels are often very detailed and precise, but his penmanship was so execrable, his local names so imaginative, and his specimens so badly preserved that some subsequent students (e. g. Turrill, 1915: 15) have considered his specimens practically useless. This is far from being the case; Horne reached many localities never approached by earlier collectors and his specimens greatly expand our knowledge of Fijian plants. Their condition indeed leaves something to be desired; Horne's collecting methods (1881: 18-19) make one wonder how any specimens still exist. The material was subsequently handled by John Gilbert Baker, who (1883) described some 25 new species, validating some of the *nomina nuda* listed by Horne (1881: 256-269). The first set of Horne's Fijian plants is at K and a good second set is at GH; the latter set includes some numbers lacking at K which Baker must have considered expendable.

Horne began his collecting on Ovalau and Moturiki, then ascending the Rewa River on Viti Levu as far as the lower Wainimala River. From his base in Levuka he next made a short trip to Tailevu Province on the adjacent Viti Levu coast. His first extended trip took him to the island of Rambi and the northern and eastern parts of Vanua Levu; during this trip he crossed Vanua Levu from Savusavu Bay to Nanduri and again from the Wainikoro River to Natewa Bay, returning from Rambi to Levuka on a mail steamer with stops at the islands of Lauthala, Vanua Mbalavu, Mango, Kanathea, Taveuni, and Koro. Next the tireless traveller spent some time based in Suva, already the selected capital of the Colony, making many excursions into the forested areas of the vicinity. An ambitious tour of interior Viti Levu was then undertaken, by way of the Navua River and overland to Namosi, from which Horne ascended Mt. Voma. From Namosi, Horne and his travelling companion, a Mr. Langton, made a remarkable crossing of the rugged terrain north of the Navua River to the Singatoka River. From Fort Carnarvon (the present village of Natuatathoko), after an excursion to the west as far as Mt. Koromba (in the present Mba Province), they ascended the valley of the Singatoka to Nandrau and thence travelled eastward over the central plateau and followed the Wainimala nearly to its mouth. From the village of Korovatu they proceeded southward to the Waindina River and back to the south coast near Suva. The return to Levuka by steamer took Horne completely around Viti Levu, with many coastal stops. Next he went to Mbua, in western Vanua Levu, and thence overland to the Wainunu River. Here Horne was prevailed upon to travel by cutter along the south coast of Vanua Levu and to Taveuni. Apparently some time was spent on Taveuni, where many plantations along the eastern and southern coasts served as bases. Finally Horne returned to Levuka by steamer, calling at the island of Makongai.

From the preceding itinerary the reader will infer that Horne must have been a vigorous and resolute traveller. On Viti Levu and Vanua Levu he certainly made plant collections in areas of very difficult access, many of them not since visited by a botanist. Even though interior trails were better and villages were more numer-

ous and larger a century ago than they are today, one must admire the energy and determination of a sometimes maligned collector.

1881. *Curt Weber* is known to have collected some 325 specimens in Samoa and Fiji between 1881 and 1883 (Urban, *Geschichte des Königl. Bot. Mus. Berlin-Dahlem*, 408. 1917). I have noted his specimens cited in a very few discussions of Fijian plants, but his numbers *111* and *112*, collected in October on Taveuni, have typified new species of palms described by Max Burret. It seems probable that Weber was at least temporarily a resident of Samoa and that his stay in Fiji was brief; he may have been primarily interested in palms and other monocotyledons. Apparently his collections of herbarium material were deposited only at B and have subsequently been destroyed.

1889-1914. Suva became the capital of Fiji in 1882, and one of Horne's recommendations was implemented in 1889 when a Botanical Station was established there. *Daniel Yeoward*, who had been trained at Kew, was appointed its first Curator. Yeoward kept this position until his retirement in 1914, and he was responsible for the development of the site. A herbarium was started by Yeoward, but apparently all of his collections were sent to K; his specimens are well prepared and are numbered up to more than 600, several of them serving as holotypes. For the most part his material was obtained in southeastern Viti Levu or from plants he had brought into cultivation. By 1912 the site had become known as the Suva Botanical Gardens and its control had been assumed by the Fiji Department of Agriculture. It is still a pleasant and valuable garden, containing many living plants of unusual interest (J. W. Parham, 1948). In 1947 the Suva City Council took over the responsibility for the Gardens (J. W. Parham, 1959b).

1897-1899. The geologist *Henry Brougham Guppy*, after spending a year observing the Hawaiian volcanoes and other features of that archipelago, devoted two years and three months to a study of plant distribution in Fiji and the geological structure of Vanua Levu. His principal concern was to add to the geological knowledge of that island, which he explored in great detail, examining most of the interior hills and mountains for the first time from a scientific point of view, as described in the first volume of his extended account (Guppy, 1903). Guppy acquired his interest in plant distribution and dispersal while serving as surgeon on H.M.S. *Lark* in the Solomon Islands in 1884. After sojourns on Keeling Atoll and western Java, and those in Hawaii and Fiji mentioned above, Guppy examined the littoral flora of western South America in 1903 and 1904. His second volume on the Pacific (Guppy, 1906) presents many original concepts and expands upon various dispersal mechanisms and principles of plant distribution. The book includes perceptive botanical observations and, in at least two cases, perhaps inadvertent descriptions of new Fijian species. Apparently Guppy preserved very few herbarium vouchers to support his observations in Fiji; a limited number have been located at K, but none are retained at CGE (S. M. Walters, in litt.). As an instance of the inconsequence of time in Fiji, I recall that when I visited a plantation on Savusavu Bay, Vanua Levu, in 1933, my genial host remarked, "You must know another scientist chap we had here a few years ago, name of Guppy . . . capital fellow."

1898. A few collections by *Frances C. Prince* were made in Fiji during August and September. They are deposited at GH, but most labels bear no field numbers or locality data.



FIGURE 12. (Upper) The Mathuata Range on the north coast of Vanua Levu, as seen from the sea. (Lower) A pond on the Seanggangga Plateau, Vanua Levu, with dominant aquatic plants of *Eleocharis dulcis* (from Smith 6887).

1898–1907. *Adolph Brewster Joske*, a long-time resident of Fiji, sent a few specimens to K; the earliest date I have noted is January, 1898, but perhaps the dates here suggested are not adequately inclusive. In 1907 he was Resident Commissioner for Tholo North and was helpful to Lilian Gibbs during her stay at Nandarivatu.

1899. During a voyage of the U.S. Commission of Fish and Fisheries Steamer *Albatross*, a comparatively few herbarium specimens were collected in Fiji by *Henry Frank Moore*. These specimens, deposited at US, seem mostly to have been obtained from islands in the Lau Group and probably for the most part in December, 1899.

1904–1910. Sir *Everard im Thurn*, during the period when he was Governor of the Colony of Fiji, maintained a lively interest in the indigenous flora. Im Thurn's name is known to students of South American plants largely because he was the first to make an ascent (albeit with a distressingly short stay on the summit) of the famed Mt. Roraima, on December 18, 1884. In Fiji most of im Thurn's collections were made on Viti Levu near Nandarivatu, but he also collected near Suva and on the island of Kandavu. He ascended Mt. Mbuke Levu on the latter island in March and again in April, 1905, and botanized on the summit of Mt. Tomanivi, Viti Levu, on May 1, 1905. His collections in Fiji were probably fewer than 200 numbers, but they are important because of the report by Turrill (1915). His first set is at K, but there are many duplicates at BM and a few elsewhere.

1905–1922. The first Superintendent of Agriculture in Fiji, *Charles Henry Knowles*, established the Department of Agriculture and some of the present introduction stations. Although primarily interested in plants with agricultural potential, he collected a number of herbarium specimens which are deposited at K; apparently none of them were retained at SUVA.

1907. The intrepid explorer *Lilian Suzette Gibbs* spent a period of about three months, August to October, collecting in Fiji. She was most interested in the montane flora of Viti Levu and therefore made her headquarters at Nandarivatu, in the present Mba Province. Travelling overland by way of the Wainimala River route and Nasonggo, she obtained approximately 50 collections enroute in the present Naitasiri Province. She seems to have made two ascents of Mt. Tomanivi, in September and October. I have noted specimens numbered between 501 and 897, but a few are unnumbered and there are some mixtures; therefore more than 400 collections are represented. The first set is at BM and a good duplicate set is at K. Gibbs's plants acquire importance from her published report (1909), which contains interesting ecological observations and descriptions of many new species.

1912–1915. *Karl Gehrman* collected extensively in Indonesia, especially in New Guinea, and presumably he stopped briefly in Fiji enroute to or from that area on one of his expeditions. The date of his Fijian collections cannot be more precisely stated, but probably his visit was brief, as only a few specimens collected there by him have been cited; they are deposited at WRS� (formerly BRSL). Gehrman published items on cacao and other crop plants of Samoa.

1914–1923. *Charles Harold Wright*, a member of the Fiji Department of Agriculture, was particularly interested in Fijian plant names; he also collected a limited number of specimens now deposited at K; apparently none were retained for SUVA.

1917–1952. A long-time resident of Fiji associated with the Colonial Sugar Refining Co. was *William Greenwood*, who was a student of plants by avocation and who

acquired a keen knowledge of the Fijian flora. Although he professed a particular interest in the adventive and cultivated plants (Greenwood, 1943, 1944, 1949), he made many excursions into undisturbed areas and obtained herbarium specimens which are well prepared and accompanied by carefully detailed notes. His principal residences were Lautoka, in Mba Province, Viti Levu, and Lambasa, in Mathuata Province, Vanua Levu, centers of the sugar cane industry. Greenwood spent long periods foraging for unusual plants throughout the two large islands, but his most important material comes from the Mt. Evans Range, near Lautoka, and the Mathuata coast. His collection numbers extend up to about 1300, but it was his custom to add letters when he thought a subsequent collection represented the same species; consequently his Fijian collections are at least 2,000 in number. Of the earlier numbers the first set is at K and of the later numbers at A, but many duplicates are to be found at BISH, BRI, NY, US, and elsewhere.

1922. The University of Iowa sent a scientific expedition of several members to Fiji and New Zealand during the summer of 1922 (Nutting et al., 1924). The botanist, *Robert B. Wylie*, contributed a chapter (pp. 142-153) to the report, discussing his Fijian work. He was in Fiji from June 5 to July 12, spending most of the time on Viti Levu but also visiting the coral island Makuluva, south of Lauthala Bay. On Viti Levu, Suva served as headquarters, but a trip was made to Namosi by way of the Navua River. No doubt botanical collections were made, and they are probably at IA, but I have seen no duplicates in major herbaria.

1922-1947. *Helena Beatrice Richenda Parham* (Mrs. *Charles John Parham*), a long-time resident of Fiji, developed a keen interest in the indigenous flora, with particular reference to Fijian plant names and uses (H.B.R. Parham, 1943). However, she also prepared many herbarium specimens, a number of which were obtained in Mbua Province, Vanua Levu, especially from the vicinity of Rukuruku Bay, where she lived for ten years, 1922-1932, remaining there after her husband died in 1926. She lived in Suva from 1932 to 1947, collecting in parts of southern and south-eastern Viti Levu and especially in Nandronga & Navosa Province in the area inland from Singatoka. Her numbering sequence was not systematic, in that numbers are frequently repeated or lacking, but probably approximately 1,000 specimens were distributed by her, mostly to BM but sometimes to GH or elsewhere. Included among her collections, but not always attributed to them, are specimens obtained by *C. J. Parham* and their daughters *Beatrice Frances Henrietta Charlotte Parham* and *Helena Florence Leda Parham*.

1923-1942. *Wilfred Laurier Parham*, second son of C. J. Parham, collected a comparatively limited number of herbarium specimens, which are deposited at K under his own name (sometimes as "L. Parham") or at SUVA in the DA sequence. Specimens collected in 1923-1930 are mostly from Rukuruku Bay, Vanua Levu; in 1930 he joined the Fiji Department of Agriculture and later collections are often from Lambasa, Vanua Levu, or the vicinity of Korovou, Tailevu Province, Viti Levu.

1924. As a member of the Whitney South Seas Expedition of the American Museum of Natural History, best known for its collections of birds, *Edwin Horace Bryan, Jr.*, had an opportunity to make plant collections in Fiji during August and September. His botanical material comes from southern Viti Levu, some islands in Loma-i-Viti, and also from the Lau Group. Members of the Expedition went ashore on practically every island in Lau, and Bryan's specimens are of particular value

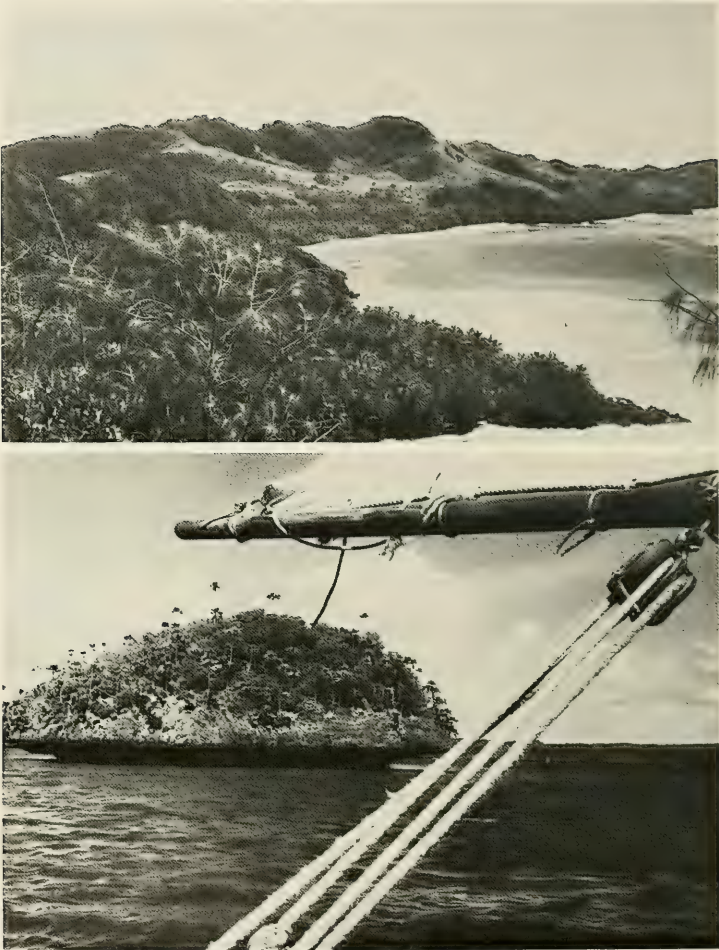


FIGURE 13. (Upper) The southern portion of the eastern side of Vanua Mbalavu, as seen from the adjacent islet of Malatta; the nearer portion of the island is of limestone, while the portion farther north shows the reed-covered slopes that typically indicate volcanic soil on the Lau islands.

(Lower) An undercut limestone islet in the lagoon of Fulangā, showing the palm *Pritchardia thurstonii*, endemic to the Lau Group.

because they represent the only herbarium material available from some of the seldom visited Lau islands. His field numbers in Fiji extend approximately from 200 to 600; the first set is at BISH and a limited number of duplicates are at A, MO, NY, US, and perhaps elsewhere.

1925-1929 and later. *John Douglas Tothill*, an officer of the Fiji Department of Agriculture (Superintendent of Agriculture and Chairman of the *Levuana* Campaign), and his wife, Mrs. *B. H. Tothill*, made critical plant collections over a long period of time, although I cannot circumscribe their botanical activity by firm dates. Tothill was particularly active in studying control of the coconut moth, *Levuana iridescens* (Tothill et al., 1930). It is probable that most of the plant collections were made by Mrs. Tothill, but this is not indicated on their labels and consequently in the present work I shall cite the specimens merely as *Tothill*. Particular attention was paid to grasses (Summerhayes & Hubbard, 1927, 1930). Numerous islands were visited by the Tothills in the course of agricultural duties, including some in Lau and in Loma-i-Viti from which otherwise we have very limited material; they also travelled extensively on the two major islands. Frequently they were accompanied by colleagues or visitors whose plant collections may bear a *Tothill* label; this is the case with *W. Teulon* and sometimes with *L. H. MacDaniels*. Herbarium numbers extend upward to at least 800, but often secondary letters were used or specimens were unnumbered; actually considerably more than 1,000 separate collections are represented in the series. The first set is at K, but duplicates are also noted at BISH, NY, US, and elsewhere.

1926. Between May and July *William Albert Setchell* and *Harold Ernest Parks* collected plant specimens in Fiji, for the most part limiting their efforts to southeastern Viti Levu. Their herbarium numbers in Fiji have been noted as approximately from 15000 to 15644. The first set of their material is at UC, but duplicates have been distributed to BISH, BM, MO, US, and doubtless elsewhere.

1927. During his travels in the Pacific, *Laurence Howland MacDaniels*, whose primary interests were in horticultural plants, made a short visit to Fiji. He collected a limited series of herbarium specimens, mostly during April and with numbers approximately from 1000 to 1200 and mostly, if not entirely, from Viti Levu. These are deposited at BISH, with some duplicates at A, K, and perhaps elsewhere. Some of the K sheets bear lower numbers.

1927. *John Phillips Mead* made a survey of the forest resources of Fiji, during which he prepared a limited number of herbarium specimens which are deposited at K. Most, if not all, of these come from Viti Levu and bear field numbers in the 1900's.

1927. *Harold Ernest Parks*, an experienced plant collector associated with the University of California, who also worked in the Societies, Cook Islands, and Tonga, as well as in Fiji with *Setchell*, revisited Viti Levu and collected extensively there for about ten weeks between April and July (Gillespie, 1930). In addition to visiting areas near Suva in southeastern Viti Levu, he obtained important collections in the vicinity of Nandarivatu. His first set of Fijian plants is at UC, but many duplicates are available at BISH, US, and elsewhere. Gillespie studied and reported upon Parks's specimens in connection with his own. The specimens collected by Parks in Fiji in 1927 bear numbers approximately from 20000 to 20980.



FIGURE 14. Part of the limestone area of northern Vanua Mbalavu, in the Bay of Islands.



FIGURE 15. (Upper) The view to the west from Suva, Viti Levu, across Suva Harbor. In the center is shown the conspicuous landmark Mt. Rama (Joske's Thumb) (442 m.), 15 km. distant. Immediately to the left of this is Mt. Voma (923 m.), 32 km. away, and to the right are the jagged peaks of the Korombasambasanga Range, about 39 km. distant.

(Lower) Some of the volcanic plugs of the Korombasambasanga Range as seen from the northwest. The sharp peak, Vuimasia (1,203 m.) is the second highest point of Viti Levu.



FIGURE 16. (Upper) The lower portion of the Namata River, Tailevu Province, Viti Levu, flanked by mangrove swamps.

(Lower) The island of Mbau, off the Tailevu coast of Viti Levu, has a place in Fijian history far exceeding its size. This offshore stronghold served as the base for powerful chiefs, including the famous Cakobau, who was proclaimed King of Fiji on June 5, 1871.



FIGURE 17. (Upper) A view from Mt. Korombamba (429 m.) over Suva Harbor. The city lies on a peninsula, while the town of Lami is in the middle foreground. Suva Harbor is one of the best in the Pacific, protected from all weather by reefs and entered only by the Levu Passage at the extreme right.

(Lower) A view over southeastern Viti Levu from Mt. Korombamba. On the extreme right are faintly seen the peaks of the Korombasambasanga Range, 36 km. distant. Other high areas seen in the distance are Mt. Voma and Mt. Vakarongasiu (860 m.). Mt. Korombamba, in spite of its proximity to Suva, has disclosed several species of plants not yet known elsewhere.



FIGURE 18. (Upper) Mt. Koromba at sunrise, seen at a distance of 25 km. from Nandi. This is one of the areas (1,075 m.) that is high enough to support a forest above the surrounding dry areas of western Viti Levu.

(Lower) The valley of the middle Singatoka River, Viti Levu. In the distance are seen clouds over the Rairaimatuku Plateau and the beginning of the forest that covers eastern Viti Levu, in contrast to the dry zone in the foreground.



FIGURE 19. (Upper) Mt. Tomanivi (1,323 m.), seen from the west at a distance of about 24 km., is the high point of Viti Levu and of Fiji. From it the densely forested land slopes gradually to the south coast of Viti Levu, some 76 km. distant.

(Lower) The eastern face of the main ridge of the Mt. Evans Range, Viti Levu, seen from a flanking ridge. Mt. Koroyanitu (1,195 m.) is the third highest point of Viti Levu. The Mt. Evans Range, isolated in the dry area of northwestern Viti Levu, is high enough to be well forested.

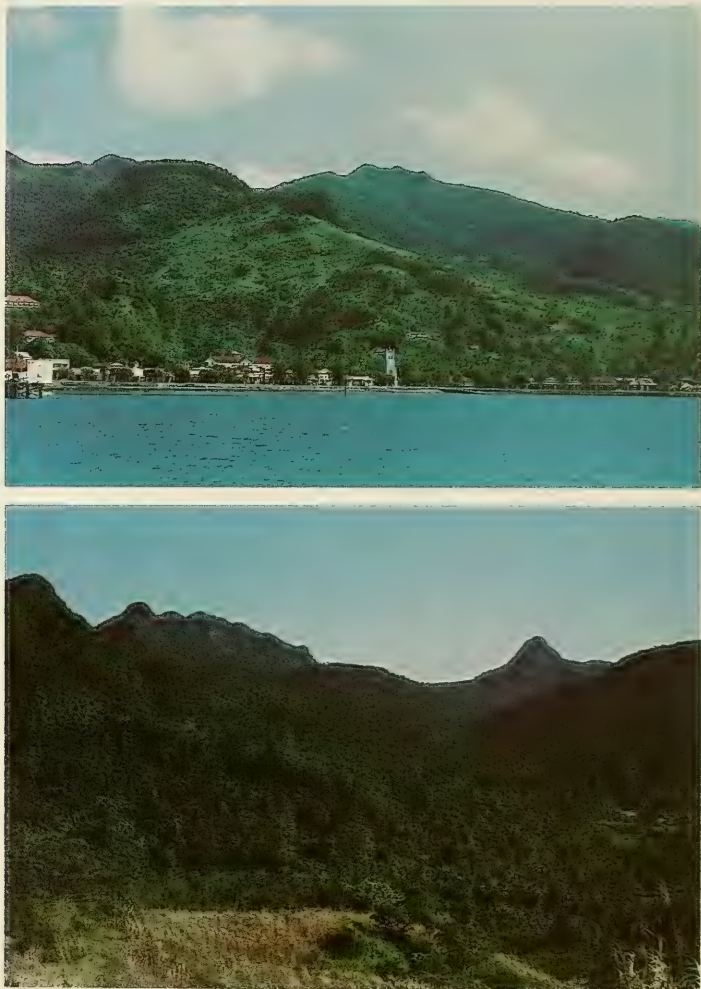


FIGURE 20. (Upper) Levuka, on the eastern coast of Ovalau, was well established as the principal European settlement in Fiji as early as 1840. Having no real harbor and little expansion space, it had given way to Suva as the principal port and capital by 1882.

(Lower) The Lovoni Valley, the central crater of Ovalau, is enclosed on three sides by densely forested hills.



FIGURE 21. (Upper) A view across the eastern end of Savusavu Bay, Vanua Levu, shows the Valanga Range and, to the right, Mt. Mariko (881 m.).

(Lower) From Taveuni one looks across Somosomo Strait to the dry southeastern hills of the Natewa Peninsula, Vanua Levu.



FIGURE 22. (Upper) Western Vanua Levu, between the valleys of the Ndreketi and Wainunu Rivers, is a densely forested area that is scarcely known botanically. On the right is Mt. Ndelanathau (774 m.). (Lower) A view at low tide across Mbutha Bay, Natewa Peninsula, Vanua Levu, looking south-eastward through the mouth of the Bay to the high island of Taveuni, about 25 km. distant.



FIGURE 23. (Upper) The main ridge of Taveuni from the south; the eastern slope of this range doubtless has the heaviest rainfall in the archipelago. The high point shown here, Mt. Uluinalau (1,241 m.), about 13 km. distant, is the second highest point of Fiji.

(Lower) The "lake" east of Somosomo, Taveuni, lying near the northern end of the main ridge of the island, has been visited by many botanists. The immediate vicinity is locally famous as being the home of the *tangimauthia* (*Medinilla waterhousei*, Melastomataceae), often considered Fiji's most beautiful flowering plant.



FIGURE 24. *Agathis vitiensis* (Araucariaceae), the *ndakua*, the largest species of tree in Fiji, is here shown in the forest near Nandarivatu, Viti Levu. The trunk sometimes attains a diameter of 3 m. above the comparatively small buttresses.



FIGURE 25. (Upper) *Halophila ovalis* (Hydrocharitaceae), in the shallow water of Mbutha Bay, Vanua Levu (DA 16896), \times about 1.4. Mixed with it are a few narrow leaves of *Halodule pinifolia* (Cymodoceaceae).

(Lower) *Halophila minor* (Hydrocharitaceae), on a fringing reef of Tavenui (DA 16903), \times 2.



FIGURE 26. *Collospermum montanum* (Liliaceae), a plant held in a shaft of light in the dark forest of a ridge above Nandarivatu, Viti Levu (Smith 4963), \times about $1/4$.



FIGURE 27. *Gahnia vitiensis* (Cyperaceae), growing on the summit ridge of Mt. Tomanivi, Viti Levu (Smith 5153).

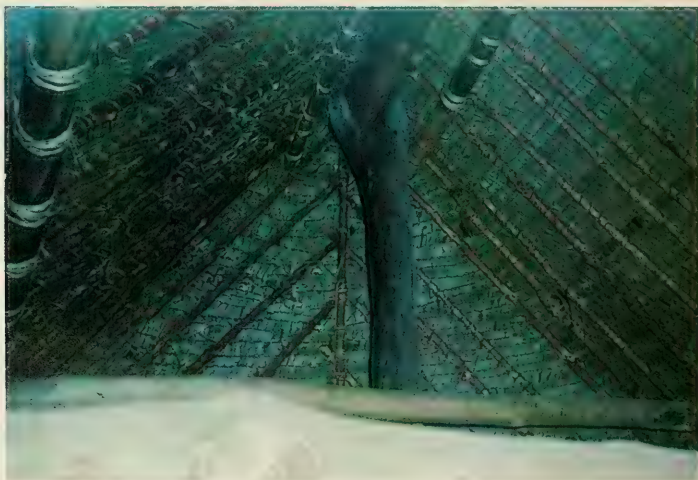


FIGURE 28. (Upper) A grove of the palm *Metroxylon vitiense* growing near Ngaloa on the south coast of Viti Levu (Smith 9339).

(Lower) The interior of the roof of a house in Ngaloa, Viti Levu, thatched with *Metroxylon vitiense*. The pinnae of the palm frond are detached, folded, and individually sewn over the stem of a reed about 2 m. long; after being dried in the sun, these "shingles" are then tied to the roof frame. Houses are built without the use of metal, and such thatch, considered the best in Fiji, often lasts for 30 years without repair.



FIGURE 29. A grove of *Pandanus vitiensis* (Pandanaceae) growing in the forest near Nandarivatu, Viti Levu (Smith 4917); the individual pandan trees are 10–15 m. high.



FIGURE 30. (Upper) A syncarp of *Pandanus vitiensis* (Pandanaceae) with some drupes detached, collected at Tholo-i-suva, Viti Levu (DA 16697), \times about 1/3.

(Lower) Syncarps of *Freycinetia impavida* (Pandanaceae) from a plant on Mt. Korombamba, Viti Levu (DA 16547), about natural size.

1927–1928. *John Wynn Gillespie* is known to students of Fijian plants from his three papers (Gillespie, 1930, 1931, 1932) discussing his own and Parks's collections and describing many novelties. As a Bishop Museum Fellow in Yale University he made extensive and important plant collections in Fiji between July, 1927, and April, 1928. On Viti Levu he visited the forested areas within a 16 km. radius of Suva, subsequently ascending the Navua River and collecting in Serua and Namosi Provinces, in the latter obtaining valuable material from such mountains as Naitarandamu, Voma, and Vakarongasiu. About two months were spent with Nandari-vatu as a headquarters. Both Gillespie and Parks made independent ascents of Mt. Tomanivi, the highest peak in Fiji. Additionally a short stay was made on the eastern side of Ovalau and a few weeks were spent on Taveuni, with Waiyevo as a headquarters. Gillespie's death at an early age on September 13, 1932 (Gregory, 1933: 11), while he was returning to his home in Arizona from a visit to Kew, was a serious loss to Pacific botany. His Fijian collection numbers range from approximately 2000 to 5117; his first set is at BISH, but a good second set is available at UC and many other duplicates are deposited at GH, K, NY, US, and elsewhere.

1928. *Einer Halfdan Steemann Nielsen* was a member of the *Dana Expedition* of 1928–1930. Enroute to Australia and Malesia the Expedition stopped in Samoa and Fiji. The stop in Fiji was brief, November 11–20 (cf. *The Carlsberg Foundation's Oceanographical Expedition Round the World 1928–30. Dana Report No. 1*, 10, 1934), but Nielsen made at least a few collections, probably all from Viti Levu, deposited at C.

1930. *R. A. Sykes*, while Conservator of Forests in Mauritius, made a survey of timber resources in Fiji, incidentally collecting a number of herbarium specimens which are deposited at K, with a few duplicates at A and perhaps elsewhere.

1930–1938. *Alfred Meebold*, an indefatigable world traveller with botanical interests, obtained many valuable herbarium specimens from Viti Levu. Presumably he visited Fiji on several occasions, as I note field numbers in his apparently chronological sequence in the 8000's, 16000's, 17000's, 18000's, 21000's and 26000's. These seem to have been somewhat unsystematically distributed to such herbaria as BISH, BM, K, NY, and perhaps elsewhere. Possibly the listed years are not sufficiently inclusive.

1933–1934. *Albert Charles Smith*.¹ The itinerary of my first collecting trip in Fiji, October 3, 1933, to July 3, 1934, has been outlined (Smith, 1934, 1935, 1936), and here I shall merely list the islands visited and the corresponding collection numbers (1–2007), mentioning mountain areas of particular interest. Kandavu (nos. 1–323), with an ascent of Mt. Mbuke Levu. Vanua Levu (nos. 324–715, 804–836, 1513–2007) in Thakaundrove Province, with ascents of Mt. Mariko, the Korotini Range, Mt. Mbatini (high point of Vanua Levu), Mt. Ndikeya, Mt. Uluingala (high point of

¹Since *Flora Vitiensis Nova* is largely a personal *Flora*, I shall use the first person in discussing my own collections and conclusions. Like most professional plant collectors, I have numbered my specimens in a single numerical sequence unencumbered by coded additions to show areas or dates. My first tropical collecting was in company with Ellsworth Paine Killip between 1926 and 1929 in Colombia, Peru, and Brazil. Since Killip's numbers at that time were in the 13000's, the *Killip & Smith* sequence extends from 14001 to nearly 31000. Starting to collect independently in Fiji, I began with no. 1. My numbers 2101–3678 were collected in British Guiana and adjacent Brazil in 1937 and 1938; those in the 10000's were collected in the West Indies in 1956.

Natewa Peninsula), and in Mbua Province, with an ascent of Mt. Seatura (high point of Mbua). Taveuni (nos. 716-803, 837-934), with ascents to the main ridge in various places including the crater lake east of Somosomo and Mt. Uluingalau (second highest point of Fiji). Koro (nos. 935-1105). Fulanga (nos. 1106-1232). Kambara (nos. 1233-1303). Moala (nos. 1304-1404). Vanua Mbalavu (nos. 1405-1512). Ten essentially complete sets were obtained, the first being at BISH, the second at NY, and others at K, P, US, B, GH (with special groups at other Harvard herbaria such as AMES and FH), UC, S, and BO. Wood specimens numbering 817 and herbarium vouchers for them were deposited at Y. On this trip my principal Fijian assistant was *Manoa Camavuto*.

1933-1956. *Bayard Eugene Vincent Parham*, youngest son of C. J. Parham, after being briefly in Fiji in the 1920's, was very active in Fiji for the extended period of time when he was an officer of the Department of Agriculture (stationed at Nanduruloulou, Naitasiri Province, Viti Levu, from 1933 to 1943 and subsequently in Suva). He contributed many valuable papers on the agricultural, horticultural, and weed plants of Fiji; these are listed by J. W. Parham (1964, 1972) and here I note only his comprehensive discussion of Fijian plant names (B. E. V. Parham, 1942). In 1933 Parham founded the Fiji Herbarium, which has developed into the important depository (SUVA) housing herbarium material of the Fiji Departments of Agriculture and Forestry (see below under J. W. Parham). Parham was deeply interested in the indigenous flora and took every available opportunity to prepare herbarium specimens. These come from many islands, but often from areas of difficult access on the two major islands such as Mt. Voma and the Korombasambasanga Range in Namosi Province, Viti Levu. Selected specimens of a numbered sequence extending to more than 3000 were sent to A, and the original set of this sequence became the basis of the collections now available at SUVA. Since these numbers initiated a series which now approximates 19000, in the present work they will be cited as *DA*; but a major portion of the first 6,000 or 7,000 *DA* numbers represents Parham's individual efforts. From 1956 to 1964 he was with the Department of Agriculture in Apia, Samoa, and subsequently with the Department of Scientific and Industrial Research in Christchurch, New Zealand.

1937, 1938. *Harold St. John* spent periods of several weeks in Fiji and obtained an excellent series of herbarium specimens numbered in his sequence approximately from 18000 to 19000. Many of these were obtained in the Yasawa Islands, which otherwise have been visited by very few plant collectors, while others come from an interior portion of Viti Levu difficult to reach and little known botanically. This is the area drained by the upper Wainimala River in Naitasiri Province and extending across the central plateau into the drainage of the Singatoka River in Nandronga & Navosa Province. St. John also collected inland from the southern coast of Viti Levu in Serua Province. The first set of his specimens is at BISH and a good second set is at US; other duplicates are available at GH and elsewhere. Subsequently St. John collected on the island of Rotuma, administratively a part of Fiji, but his Rotuman specimens have not been made available. Since no other herbarium material of consequence exists from Rotuma, I have omitted this island from consideration in the present work; it lies considerably north of Fiji proper and its flora is probably more closely allied to that of the Horne and Wallis Islands than to that of the Fijian archipelago.

1937. *Arnold Wall* obtained a comparatively few herbarium specimens in Fiji; these are deposited at AK, but those I have seen lack field numbers and locality data.

1940–1941. During the 1930's Mrs. *Anne Archbold*, of Washington, D.C., in pursuance of her interest in tropical exploration, commissioned the building in Hong Kong of the yacht *Cheng Ho*, patterned after a fifteenth century Chinese junk. In the *Cheng Ho* Mrs. Archbold made two extended exploratory trips, the first in the Philippines–Moluccas area with David Fairchild as botanist, and the second in more easterly Pacific archipelagoes. On the second trip *Otto Degener* was invited to serve as botanist. Joining the *Cheng Ho* at Suva in November, 1940, Degener (1943, 1949) made extensive plant collections in Fiji until June, 1941. Among his assistants, *Emilio Ordonez*, *Aloisio Tabualewa*, and *Timoci Bebe* should especially be named as participating in botanical efforts. Degener's collections come in part from Thakaudrove Province, Vanua Levu, where he worked in the vicinity of Savusavu Bay as far west as the Yanawai River. On Viti Levu he was active in several areas, the most significant material perhaps coming from the vicinity of Nandarivatu and southward to Nandrau in Nandronga & Navosa Province, from Ra Province near Viti Levu Bay, and from the Serua hills of the south coast. A few collections were also made on some of the Loma-i-Viti islands. Degener's numbers during this period extend from 13500 to 15642, approximately the last hundred of which were obtained after his departure by *Tabualewa*. The first set is deposited at A and other appropriate Harvard herbaria, an essentially complete second set at NY, and other sets at BISH, K, MO, S, UC, US, and many other depositories. The botanical collections of the second *Cheng Ho* expedition greatly extended our knowledge of the indigenous plants of Fiji (Smith, 1942).

1941–1947. *Lorna Reay* (later Mrs. Lorna Paley), a Fiji Government employee stationed for a time at Nandarivatu, Viti Levu, made a few collections from that interesting locality, these being deposited at A. The indicated dates may not be sufficiently inclusive.

1941–1977. *Noel Louis Hilmer Krauss*, an entomologist based in Hawaii, visited Fiji on different occasions during his studies of biological control of insect pests. He collected a number of herbarium specimens, mostly on Viti Levu and Vanua Levu; these are deposited at BISH.

1945. *V. J. Livingston* obtained a comparatively few herbarium specimens on Viti Levu; the material is unnumbered and is deposited at US.

1946–1947. *J. H. Vaughan* made a series of comparatively few but excellent plant collections in Fiji during a visit extending at least between November and February. He visited several areas of Viti Levu, including southern and western coastal localities and the vicinity of Nandarivatu. His Fijian field numbers extend approximately from 3200 to 3500; the first set is at BM but a nearly complete set is at K, and a limited number of duplicates have been seen at US.

1947–1948. *A. C. Smith*. On my second opportunity to further botanical studies in Fiji, I arrived in Suva on April 5, 1947, and left on January 12, 1948. As my itinerary has been briefly detailed (Smith, 1950: 138–141), only a few points will be here elaborated. Collection numbers used on this occasion were 4001–6912, and my principal objectives were some of the botanically lesser known parts of Viti Levu (nos. 4001–6329) and Vanua Levu (nos. 6330–6912). A considerable period was spent in

the Mt. Evans Range, northwestern Mba Province (nos. 4001–4501), where ascents were made to several high points including Mt. Koroyanitu (third highest point of Viti Levu). Subsequently (nos. 4502–4727) a trip was made inland from Nandi, during which areas in Mba Province (including Mt. Koromba) and Nandronga & Navosa Province (southern Nausori Highlands) were visited. An extended period with Nandarivatu as a headquarters (nos. 4751–6329) was profitable; during three months I worked eastward and southward into adjacent parts of Ra, Nandronga & Navosa, and Naitasiri Provinces, collecting on the northern portion of the central plateau and on different slopes of Mt. Tomanivi, reaching its summit on July 10 and September 6. Mathuata Province on Vanua Levu was visited for a couple of months. First I collected in the area inland from Lambasa (nos. 6330–6633), especially on the nearby Mt. Numbuiloa. Subsequently Natua (nos. 6634–6912), on the Korovuli River inland from Nanduri, served as a headquarters for study of part of the Ndreketi River drainage basin. Of the ten essentially complete sets obtained on this trip, the first is at A (with special groups at other Harvard herbaria), the second at US, and others at K, BISH, NY, P, L, UC, S, and BRI. Several hundred wood specimens were deposited at A. During this trip my principal Fijian assistant was *Taniela Rawaqa*.

One of the high points of my 1947 collecting was the rediscovery, on August 7, on the western edge of the central plateau of Viti Levu, of *Degeneria vitiensis*; this fourth known collection of the species caused me to make a continuing search for it. Subsequently, with the aid of competent field crews, I located and studied 64 different trees within 25 km. of Nandarivatu. From several of these, quantities of herbarium specimens in all stages were prepared and wood samples were obtained.

1948–1970. *John Willoughby Parham*, son of B.E.V. Parham, served for a year in the Fiji Department of Agriculture in 1948 prior to becoming Government Botanist in 1953. Under his guidance the Fiji Herbarium, Botany Section, Department of Agriculture, was greatly expanded and was housed in a new building, support for which had been obtained by B.E.V. Parham from Colonial Development and Welfare (United Kingdom) funds; later the building was equipped with steel cases and air-conditioning. With the cooperation of *James Robert Beale Angus* (Conservator of Forests from about 1950 to 1964), *Gwyn Watkins* (his successor in that post), and *Alistair S. Alston*, the Department of Forestry collections were incorporated into the Fiji Herbarium, a depository of major importance in a study of Fijian plants. It now contains about 40,000 herbarium sheets, including some from Samoa and other Pacific archipelagoes. In the present work the specimens numbered in the Fiji Department of Agriculture series will be cited as *DA* (now numbered up to about 19000), those in the Fiji Department of Forestry series as *DF* (several thousand numbers but with some repetitions or individually numbered sequences). The *DA* series includes the extensive collections of *B. E. V. Parham* and *J. W. Parham* as well as those of many other individuals, among whom may be mentioned *D. Anderson*, *D. Koroiveibau*, *I. T. Kuruvoli*, *P. Labalaba*, *H. S. McKee* (specimens also separately numbered), *R. Melville* (specimens also separately numbered), *M. Miller*, *T. L. Mune*, *S. Nand*, *S. Pillay*, *F. C. Raiqiso*, *S. Rokonaca*, *J. Samudu*, *H. W. Simmonds* (Government Entomologist in the 1920's), *S. Siwatibau*, *John Swayle Smith* (first Conservator of Forests, about 1938 to 1948), *Sundaesan*, *H. R. Surridge*, *N. Tulewa*, *C. R. Turbet*, *M. E. Turbet* (Government Botanist, approximately 1949–1953), *S. Vodonaivalu*, *B. Vunibobo*, *A. Wagatabu*, and *L. V. Waibuta*. The *DF* series in-

cludes collections made by *A. S. Alston*, *J. R. Angus*, *I. Bola* (specimens also separately numbered), *G. W. Cottle* (some also independently distributed), *E. Damanu* (also in *DA* series), *A. N. Loweth*, *I. Macunaqio*, *A. Nasoqiri*, *I. Qoro* (also in *DA* series), *K. Vaisewa*, and *G. Watkins* (specimens also separately numbered). It must not be assumed that these names exhaust those of contributors to the *DA* and *DF* series; other Fiji Government employees and interested contributors have aided in augmenting the Fiji Herbarium; I regret their anonymity in the present work under the citations *DA* and *DF*. The first set of these collections is at SUVA, but generous numbers of duplicates are now deposited at A, BISH, BRI, CHR, K, L, LAE, MASS, NY, UC, US, and elsewhere.

In addition to developing the herbarium and performing other official duties, Parham travelled extensively throughout Fiji, visiting many islands and remote parts of the two major islands. His concern with grasses (J.W. Parham, 1956) and weeds (J.W. Parham, 1959a; Mune & Parham, 1967) was supplemented by a keen appreciation of the indigenous flora. Among his many publications, those most pertinent to the present work are comprehensive lists of Fijian plants (J.W. Parham, 1964, 1972). Because his collections are modestly anonymous in the *DA* series, one can only guess that Parham has prepared some thousands of herbarium specimens. Mrs. *Margaret Elizabeth Parham* supplemented her husband's collections with some from Mathuata Province, Vanua Levu, and Naitasiri Province, Viti Levu; a few of her beautiful paintings of indigenous plants have been published (J.W. Parham, 1972). Additional "Parham" collections to be found in the *DA* series, other than those already mentioned, were obtained by *Elizabeth Helena Parham* and *Peter Joyn Parham* (daughter and younger son respectively of B.E.V. Parham) and *David John Parham* (son of J.W. Parham). Since 1971 J.W. Parham has continued his botanical activities in the Queensland Herbarium and the Tasmanian Herbarium.

1952–1976. *Judson Linsley Gressitt*, a well-known entomologist connected with the Bernice P. Bishop Museum, has made many short visits to Fiji and has collected host plants for beetles. His plant materials came mostly from Vanua Levu but some were obtained on Viti Levu; there are probably approximately 100 numbers. The first set is deposited at BISH, with a few duplicates at us.

1953–1954. *A. C. Smith*. On my third collecting trip to Fiji I reached Suva on March 29, 1953, and left on January 7, 1954. The itinerary already discussed (Smith, 1955) will be briefly recorded here. At this time I felt the parts of Viti Levu most neglected by prior plant collectors to be the Korombasambasanga Range in Namosi Province and some of the Tailevu and Serua hills. The high island of Ngau, except for the visit of H.M.S. *Herald* in 1854, remained essentially unknown botanically, and our knowledge of the plants of eastern Taveuni and central Ovalau left much to be desired. On this trip my collection numbers were 7001–9700. On Viti Levu collections were made in the lower Wainimbuka River Valley, Tailevu Province (nos. 7001–7255), in Namosi Province (nos. 8404–9152), and in Serua Province (nos. 9153–9700). In Namosi Province I followed the Navua River route of several prior botanists but continued north of Namosi village to the eastern headwaters of the Wainikoroiluva River which drain the area between Mt. Naitarandamu (visited by Gillespie) and the Korombasambasanga Range, a region of sharp basaltic peaks. I could not reach my primary objective, Mt. Vuimasia (third highest point of Fiji), be-

cause of a sharp earthquake on September 14 and continuing violent aftershocks. Nevertheless the lower slopes of the Korombasambasanga Range and also the vicinity of the confluence of the Wainikoroiluva and Navua Rivers proved botanically rewarding. In Serua Province the hills inland from the south coast between Korovou Bay and Taunovo Creek also proved of unusual interest.

On Ovalau (nos. 7256-7734, 8001-8105) the central Lovoni Valley was a headquarters for five weeks, during which the surrounding hills were ascended; these included Mt. Korolevu (west of the Lovoni Valley), Mt. Korotolutolu (north), and Mts. Tana Lailai (visited by Graeffe) and Ndelaiovalau (east), the latter being the high point of the island. During a stay on Ngau (nos. 7735-8000) collections were made on the western slopes of Mt. Ndelaitho (high point of Ngau). On Taveuni (nos. 8106-8403) an infected leg prevented me from working on the steep eastern slope, but the western slope was revisited upward to Mt. Manuka and the crater lake east of Somosomo, both familiar from my 1933-1934 trip.

Ten essentially complete sets were obtained, the first being deposited at US, the second at BISH, and the others at GH (with special groups at other Harvard herbaria), K, L, NY, UC, P, S, and SUVA. The numerous wood specimens were deposited at US. Of particular interest during this trip was the discovery of *Degeneria vitiensis* on a third island, Taveuni, in considerable abundance; it was also found in Namosi Province for the first time, and with some frequency. During this trip my principal Fijian assistant was *Berenado Vunibobo*, who subsequently has held several Fiji Government appointments, including that of Director of the Department of Agriculture and Fiji Ambassador to the United Nations in New York.

1955. *Hugh Shaw McKee*, a botanist with many years of experience in New Caledonia and other Pacific archipelagoes, visited Fiji briefly in July and collected (nos. 2737-2861) on Viti Levu. The best set of these numbers is at US and some are duplicated at E, K, L, and SUVA.

1955. *Jacques Barrau*, under the auspices of the South Pacific Commission, visited Fiji in connection with his survey of native subsistence agriculture in the south Pacific. A limited number of specimens representing food plants was collected and deposited at BISH. Barrau's work in the Pacific has been summarized in several publications (1958, etc.)

1960. *M. Hotta* collected briefly in Fiji in the latter part of the year, probably only on Viti Levu, enroute from his more extensive field work in Tonga. His Fijian specimens are numbered in his 3000 series. The first set is probably deposited at KYO, with duplicates at BISH and perhaps elsewhere.

1962. *Ronald Melville*, accompanied by Mrs. *Elsie Melville* and *J. W. Parham*, made limited collections on Viti Levu, visiting the Nausori Highlands in Nandronga & Navosa Province and ascending Mt. Tomanivi in Mba Province. The specimens are deposited at K (with numbers approximately from 7000 to 7200) and at SUVA (numbered in the DA series).

1962. During one of his many explorations of tropical insular areas, *Sherwin J. Carlquist* collected a number of herbarium specimens in Fiji, at that time being especially interested in the genus *Scaevola*. His material is deposited at RSA, with some duplicates at BISH and perhaps elsewhere.

1962. Enroute to New Caledonia for one of several exploratory visits to that is-

land, *David William Bierhorst* stopped in Fiji during February and March, making collections of herbarium specimens on Vanua Levu. His material was obtained in Thakaundrove Province, between Savusavu Bay and Mbutha Bay, and an ascent of Mt. Mariko was also made. Bierhorst's specimens are numbered *F1-F225* and are deposited at MASS.

1962, 1967. *Rudolf Mathias Schuster*, while engaged in Pacific and antipodal bryological collecting, made brief visits to Fiji and obtained a number of specimens of phanerogams; these are deposited at MASS, with some duplicates at BISH and SUVA.

1963. In connection with his exploration of Norfolk Island and other Pacific areas, *Peter S. Green* made a brief stop in Fiji and obtained herbarium specimens, especially in furtherance of his research on *Jasminum*; the material is deposited at K.

1963-1971. In promoting his intensive interest in the ferns of Fiji, *Garth Brownlie* made several collecting trips, mostly concentrating on parts of Viti Levu inadequately known as regards pteridophytes. Subsequently he has recently (1977) published an invaluable book on the pteridophyte flora of Fiji. His specimens of phanerogams, comparatively limited in number, are deposited at CANU, with some duplicates at SUVA (in the *DA* series) and perhaps elsewhere.

1964. During an extensive tropical trip to advance his important studies of the Santalaceae and related families, *Hans Ulrich Stauffer* spent several weeks in Fiji making general collections. Mostly in company with Fiji Department of Agriculture assistants, he obtained many excellent herbarium specimens on Viti Levu (especially in Mba Province) and Vanua Levu (especially in Mathuata Province). The first set of his material is at Z, but some duplicates are available at SUVA, A, BISH, US, P, and elsewhere. His Fijian specimens are in Stauffer's *5000* series.

1964. *Harold Emery Moore, Jr.*, during his worldwide travels in connection with his studies of palms, spent a short period in Fiji, during which he studied and collected palms and other plants on Viti Levu, Vanua Levu, and Taveuni. His specimens are deposited at BH, with some duplicates at SUVA (in the *DA* series) and perhaps elsewhere.

1964, 1969. *Donald Anderson*, a botanist with extended experience in Micronesia and Hawaii, collected on Viti Levu and Vanua Levu, in company with Department of Agriculture assistants. The first set of his material is deposited at BISH and there is also a set at HLA; many specimens are also at SUVA in the *DA* numerical series.

1964-1974. *David J. de Laubenfels* furthered his research in Malesian and Pacific gymnosperms by making collections in Fiji. He obtained a limited number of gymnosperm specimens on Viti Levu, numbered upward from *P301*; some of these are deposited at A, K, RSA, SBT, and SUVA. Probably several visits to Fiji were made by de Laubenfels, at least one as late as 1974.

1965. *John Wyndham Dawson*, with particular interests in the family Myrtaceae, spent a few weeks in July making collections on Viti Levu, in part in the vicinity of Nandarivatu; his specimens are deposited at WELTU.

1966. *Thomas Kenneth Newell* made a brief botanical visit to Viti Levu, primarily to observe and collect material of *Joinvillea*, during a study trip of several months that he made to examine that interesting genus throughout its range. His

collections are at BISH, with duplicates in several other herbaria.

1966-1969. *Malcolm J. Berry* and *William J. Howard*, with a team of assistants, extensively surveyed the timber resources of Fiji on behalf of the Land Resources Division, Directorate of Overseas Surveys. They were working in Fiji from October, 1966 (Howard) and May, 1967 (Berry) until December, 1969. Their field work, using the catchment basins of major rivers as the principal units of survey, covered in detail the islands of Viti Levu, Vanua Levu, and Kandavu. Although to ascertain the total timber volumes of various forest types was their major objective, they also studied the occurrence of the potentially more important species of trees. In the course of this work many herbarium specimens were prepared, some of great value in that they represent inadequately known species or add to distributional data. To the best of my knowledge no published account of the work of this mission is available, but I am indebted to Messrs. Berry and Howard for access to a most valuable confidential report on its solid accomplishments. While the preparation of herbarium specimens was incidental to the main work of the survey, many such collections, probably between 2,000 and 3,000, were made. Good sets of these are available at SUVA and K, while a number of duplicates are at BISH, US, and elsewhere. Many of the specimens are incorporated into the *DA* or *DF* series and are so cited in the present work; others are labelled as collected by *Berry* (numbered up to about 800) or *Howard* (numbered up to about 500); while still others are labelled as independent collections of various assistants among those listed above as contributors to the *DA* and *DF* series.

1967. *A. C. Smith*. While in Fiji from June 12 to August 15, aided by my wife, Emma van Ginneken Smith, I began a review of the accumulated collections in the Fiji Herbarium, checking identifications, annotating specimens, and recording data pertinent to the present *Flora*. Time was too brief for completion of the task.

1968. Between July 7 and 25, *Grady Linder Webster* and *William Richard Hildreth* collected herbarium specimens in various parts of Viti Levu; their collections were obtained from the southern coastal region and inland from it, and also from the Nausori Highlands and the vicinity of Nandarivatu and Mt. Tomanivi. Field numbers extend from 14050 to 14399; the first set is at DAV, a good second set at MASS, and occasional duplicates at BISH, GH, US, and elsewhere.

1968. *Yoshio Kondo*, malacologist of the Bernice P. Bishop Museum, visited Fiji in connection with his field studies of molluscs. While there he collected material of *Pandanus* (deposited at BISH) at the behest of Harold St. John, some of his specimens being subsequently described as new. On an earlier trip Dr. Kondo did not obtain botanical specimens, but in 1968 he did so on several islands of southern Lau and also on Taveuni.

1968. In furtherance of his studies of Araliaceae and other families, *Luciano Bernardi* made a limited number of Fijian collections, which are deposited at G.

1968-1969. *Otto Degener* revisited Fiji with his wife, *Isa Degener*, collecting several hundred "numbers" of plants. Most of these came from parts of Viti Levu previously visited by O. Degener, but of especial significance are the plants obtained in the Malolo Group of the Mamanutha Islands, a region not visited by earlier plant collectors. The first set of specimens obtained by O. & I. Degener is at BISH; lesser sets are deposited at B, CHR, L, MASS, MO, NY, W, and many other deposi-

tories. The numbers utilized by the Degeners during this visit were approximately from 31990 to 32360.

1969. *A. C. Smith.* Between February 12 and August 20 Mrs. Smith and I completed a review of all collections deposited in the Fiji Herbarium. With cooperation of officials of the Fiji Departments of Agriculture and Forestry and the Fiji Herbarium staff, we sorted available duplicates into sets to be used for exchange purposes (see above under *J. W. Parham*, 1948–1970). On this occasion vouchers were collected for many of the plants cultivated in Suva and its vicinity. For a period of several weeks we were joined by *J. W. Parham*, *Philip Barry Tomlinson*, and Fiji Herbarium assistants in collecting herbarium material on Viti Levu (Rewa and Serua Provinces), Vanua Levu (Thakaundrove Province), and Taveuni, with particular attention to marine phanerogams and other monocotyledons. All specimens collected during this visit are incorporated into the *DA* numerical series. Since that time *Tomlinson* has made other visits to Fiji for purposes of botanical observation and collection, one as recently as 1977.

1969–1976. *Michael Alan Weiner*, on several occasions, spent a few weeks in Fiji engaged in ethnobotanical studies, mostly in the Yasawas and on Viti Levu, Mbe-
ngga, Taveuni, and Ovalau. He obtained more than 200 numbers of herbarium specimens, of which the first set is deposited at BISH.

1977. *Philip John Garnock-Jones*, a participant in the Royal Society of New Zealand Pacific Expedition, spent the period June 17–July 12 in Fiji, visiting the islands of Lakemba and Vanua Mbalavu in the Lau Group. He collected about 380 numbers of herbarium specimens, the first set being deposited at CHR and some duplicates at BISH and SUVA. He was accompanied by *Graeme N. MacRaid*, whose collections consisted almost entirely of algae.

One cannot be certain that the collectors discussed above complete a definitive list of those who are represented in world depositories by Fijian herbarium specimens. The more important collectors are certainly included in my enumeration, but it is probable that other travelling botanists or residents have added to our knowledge and that I have not detected their Fijian specimens or references to them. On the basis of the herbarium material known to me, there would now seem to be available in the world's botanical depositories between 50,000 and 60,000 "numbers" of Fijian botanical collections, many of which are represented by extensive suites of duplicates. It must be kept in mind, of course, that most modern collectors maintain a single numerical series for all their material, incorporating cryptogams (ferns, mosses, hepatics, lichens, and algae) into their series as material comes to hand. Since the present *Flora* deals only with gymnosperms and angiosperms, the estimate of 50,000 to 60,000 "numbers" is inflated, for our purposes, by a proportion of cryptogams difficult to assess. At a guess, I doubt if this proportion exceeds fifteen percent. The greater part of these numbers (referring to phanerogams only) has been personally examined, in one or another herbarium, by the author of the present *Flora*. Such studied specimens, supplemented by personal field observations and by the published comments of a large number of specialists, provide the essential basis for the taxonomic and phytogeographic conclusions expressed in *Flora Vitiensis Nova*.

REFERENCES

This list includes only those publications cited in the Introduction and referenced by mention of authors and dates. Many other references will be listed in the taxonomic portions of this *Flora* as pertaining to specific families and genera, and a still greater number will be recorded in abbreviated form under the accepted names for taxa and synonyms. The present list does not attempt to duplicate the list of more than 850 references to the flora of Fiji provided by J. W. Parham (1972). On the other hand, the present list includes many references not directly applicable to the flora of Fiji which are mentioned in the Introduction because of their bearing on Pacific bibliography, geography, geology, phytogeography, etc.

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KEY TO DIVISIONS

- Ovules (megasporangia) borne on surface of open carpels or cone scales (megasporophylls), essentially naked, only rarely nearly completely enclosed; flowers composed of pollen sacs and ovules usually arranged in strobili and unisexual (only rarely bisexual), without perianth and stigmas; vessels absent in secondary wood, this composed of tracheids only. GYMnosPERMAE (PINOPHYTA)
- Ovules enclosed (at least at maturity, with rare exceptions) within carpellary sporophylls comprising an ovary; flowers unisexual or bisexual, usually with a perianth (sometimes lacking) and stigmatic surfaces; vessels present in secondary wood (except in that of a few families).

ANGIOSPERMAE (MAGNOLIOPHYTA)

DIVISION GYMnosPERMAE (PINOPHYTA)

KEY TO CLASSES AND ORDERS OCCURRING IN FIJI

- Sperm cells ciliate, motile; more or less woody palmlike plants, the leaves simply pinnate; staminate sporophylls in compact strobili; pistillate sporophylls (in our order) spirally arranged in a terminal mass, with large ovules borne on margins. CYCADICAE
One order in Fiji. CYCADALES (FAMILY 1)
- Sperm cells eciliate, nonmotile; leaves often acicular or scalelike to linear, sometimes flattened and comparatively broad; staminate strobili simple; ovulate strobili usually woody cones, sometimes reduced to solitary ovules on fertile sporophylls; resin canals present. PINICAE
One order in Fiji. PINALES (FAMILIES 2-5)
- Sperm cells eciliate, nonmotile; leaves (in our order) with broad blades superficially resembling those of angiosperms; strobili compound, the microsporangiate strobili (in our order) spikelike, the megasporangiate strobili (in our order) bearing ovules arranged in verticils; resin canals absent. GNETICAE
One order in Fiji. GNETALES (FAMILY 6)

CLASS CYCADICAE

ORDER CYCADALES

USEFUL TREATMENT OF ORDER: Johnson, L. A. S. The families of cycads and the Zamiaceae of Australia. Proc. Linn. Soc. New South Wales **84**: 64-117. 1959.

It has been customary to refer all living cycads to a single family, variously divided into subfamilies, tribes, and subtribes by different authors. The most recent comprehensive treatment of the group is that of J. Schuster (in *Pflanzenr.* **99** (IV. 1): 1-168. 1932). However, Johnson's division of the order into three families, with ten genera and about 100 species, is likely to prove acceptable to most botanists (cf. Airy Shaw in Willis, *Dict. Fl. Pl. Ferns*, ed. 7. 315-316. 1966; Bierhorst, D. W. *Morphology of Vascular Plants*, 369-389. 1971). Of the three families, the Cycadaceae include only the genus *Cycas*, the Stangeriaceae the sole genus *Stangeria*, and the Zamiaceae the remaining eight genera, which Johnson divides into three tribes. Only the first of the three families is represented in Fiji.

FAMILY 1. CYCADACEAE

CYCADACEAE Pers. Syn. Pl. **2**: 630, as *Cycadeae*. 1807.

Diocious, palmlike, usually unbranched woody plants, the trunk thick, cylindric, clothed with old frond bases; leaves simply pinnate, spirally arranged to form a conspicuous crown, the pinnae with a single thick midrib, lacking lateral veins, circinate involute in bud; microsporophylls in compact cones, short-pedicellate, terminating in an upcurved upper portion, completely covered on lower surface by microsporangia; megasporophylls not forming a determinate cone but sessile and spirally arranged in a terminal mass and falling separately at maturity; central axis of plant continuing vegetative growth; blade of megasporophylls pinnatifid, pectinate or toothed, the ovules 2-several, marginally inserted in subopposite notches proximal to the lamina, obliquely directed outward.

DISTRIBUTION: Although the sole genus, *Cycas*, is in need of a satisfactory revision, it probably contains about 20 species occurring from Madagascar and eastern Africa to eastern and southeastern Asia, Malesia, tropical Australia, and the western Pacific. Some species are widely cultivated as ornamentals, and perhaps also for the edible starch of the pith of their trunks. Only one species occurs in Fiji.

1. *CYCAS* L. Sp. Pl. 1188. 1753; Seem. Fl. Vit. 268. 1868; Pilger in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. 13: 74. 1926; Schuster in Pflanzenr. 99 (IV. 1): 64. 1932.

Characters of the family.

TYPE SPECIES: *Cycas circinalis* L., the only original species.

DISTRIBUTION: As of the family.

USEFUL TREATMENTS OF GENUS: Pilger, R. *Cycas*. Engl. & Prantl, Nat. Pflanzenfam. ed. 2. 13: 74-75. 1926. Schuster, J. *Cycas*. Pflanzenr. 99 (IV. 1): 64-84. 1932. Laubenfels, D.J. de. Cycadaceae. Aubréville & Leroy, Fl. Nouv. Calédo. et Dépend. 4: 7-10. 1972.

1. *Cycas rumphii* f. *seemannii* (A. Braun) Kanehira in J. Jap. Bot. 14: 587. 1938; J. W. Parham, Pl. Fiji Isl. 40. fig. 19. 1964, ed. 2. 68. fig. 19. 1972.

Cycas circinalis sensu Seem. in Bonplandia 9: 259. 1861, Viti, 442. 1862, Fl. Vit. 268. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 353. 1892; Yuncker in Bishop Mus. Bull. 178: 19. 1943, in op. cit. 220: 45. 1959; non L.

Cycas seemannii A. Braun in Sitzungsber. Ges. Naturf. Freunde Berlin 1876: 114. 1876.

Cycas seemanni A. Braun ex Carruthers in J. Bot. 31: 2. t. 330. 1893; F. v. Muell. in Chem. Drug. Austral. Suppl. 5: 34. 1882.

Cycas rumphii sensu Kanehira in Bot. Mag. (Tokyo) 45: 273. 1931; non Miq.

Cycas circinnalis subsp. *seemannii* Schuster in Pflanzenr. 99 (IV. 1): 71. 1932.

Cycas circinalis subsp. *seemannii* Schuster ex Kanehira, Fl. Micrones. 59. 1933; Sykes in New Zealand Dept. Sci. Indust. Res. Bull. 200: 35. 1970.

Cycas rumphii var. *seemannii* J. W. Parham in Agr. J. Dept. Agr. Fiji 19: 94. fig. 7. 1948, in op. cit. 29: 32. 1959.

The only cycad indigenous in Fiji is an unbranched tree 1-12 m. high, with a trunk diameter of 10-30 cm.; it has been noted to bear fruits, which are green, becoming reddish brown and 5-8 cm. long at maturity, between April and December. It occurs from near sea level to about 600 m. in various types of forest, usually in dry places, on rocky open slopes and grassy ridges, somewhat scattered in its local distribution, but more frequent in *talasinga* areas than elsewhere.

LECTOTYPIFICATION: In describing *Cycas seemannii*, Braun did not cite a specimen, but from the epithet one may infer that he had a Seemann collection in hand. This would have been *Seemann* 572, of which I here designate the K sheet as the lectotype. Neither it nor the isolectotype at BM bear locality data, but Seemann (in 1868) mentioned the number as being from Viti Levu and Ovalau.

DISTRIBUTION: Although *Cycas rumphii* has a wide distribution extending from Malesia (including the Philippines) and Micronesia eastward to Tonga, its f. *seemannii* is known definitely to occur in Fiji, Tonga, and Niue (introduced), and probably in the Solomons and New Hebrides as well. Kanehira (in 1938, cited above) described two Micronesian forms as being different from f. *seemannii*, which he also excluded from New Britain and New Guinea. I have examined 18 collections from Fiji, but it is probably more abundant than this implies.

LOCAL NAMES AND USES: *Longolongo* is the most frequently used Fijian name, but the following are also recorded: *langolango*, *langalanga*, *roro*, *tuawawa niu*, and *wiro*. The seeds are edible when prepared into *mandrai*, a type of bread, and the staminate cones are also said to be edible. The pith of the trunk is starchy and edi-

ble; Seemann mentions that it was reserved for the exclusive use of the chiefs. It is also often grown in towns and villages as an ornamental.

AVAILABLE COLLECTIONS: YASAWAS: WAYA: Naruarua Gulch, west of Mbatinaremba, *St. John 18045*. VITI LEVU: MBA: Vicinity of Nalotawa, eastern base of Mt. Evans Range, *Smith 4486*; Navuiyari, *DA 2396*; Nawairoro, Ndreke, *DA 14751*. NANDRONGA & NAVOSA: Vicinity of Mbelo, near Vatukarasa, *Degener 15286*; Mbemana, Ruwailevu Tikina, *H. B. R. Parham 137*. REWA: Suva (cultivated), *DA 10263*. VITI LEVU without further locality, *MacGillivray 190*. OVALAU: Slopes overlooking Levuka, *Gillespie 4465*. NGAU: *Mihne 230*. VANUA LEVU: MATHUATA: Seanggangga Plateau, *DA 13198*; Mathuata coast, *Greenwood 644*; mountains near Lambasa, *Greenwood 644A*. THAKAUNDROVE: Maravu, near Salt Lake, *Degener & Ordenez 14262*; hills west of Mbutha Bay, Natewa Peninsula, *Smith 822*. MATUKU: Ridge near Ngilingilia Mt., *Bryan 276*. VANUA MBALAVU: Limestone slopes on northern end, *Bryan 578*.

Whether *Cycas rumphii* Miq. is to be included in *C. circinalis* L. or not is apparently still open to question. Stapf (in Kew Bull. 1916: 1-8. 1916) has given a good comparison of *C. thouarsii*, *C. rumphii*, and *C. circinalis*, from which one may conclude that our species is definitely *C. rumphii*, distinguishable from *C. circinalis* by its comparatively narrow pinnae, its megasporophylls distally with numerous, sharp, narrow teeth arising from a flat, broad claw, and its comparatively small seeds. Merrill (Interpret. Rumph. Herb. Amb. 74. 1917) implies that the two species are close, but that *C. circinalis* should be interpreted by the specimens from India and Ceylon, considering it best, pending a critical revision, to retain the Moluccan form as *C. rumphii*, a decision with which Backer & Bakhuizen van den Brink (Fl. Java 1: 87. 1963) concur. Schuster and Pilger (in the references given above under the genus) also maintain the species as distinct, as does Kanehira. However, Fosberg and Sachet (in Smithsonian Contr. Bot. 20: 6. 1975) take *C. circinalis* as an inclusive and highly variable species in Micronesia, submerging *C. rumphii* and Kanehira's forms in it. De Laubenfels (1972, cited above) also uses *C. circinalis* to include *C. rumphii*. This broad interpretation does not seem warranted, as most students have readily enough distinguished *C. rumphii* from *C. circinalis*.

CLASS PINICAE

ORDER PINALES

USEFUL TREATMENTS OF ORDER: Pilger, R. Coniferae. Engl. & Prantl, Nat. Pflanzenfam. ed. 2. 13: 121-403. 1926. Keng, H. A new scheme of classification of the conifers. Taxon 24: 289-292. 1975.

The sequence of families utilized by Pilger in 1926 is here followed. However, the most logical arrangement and grouping of the families of the Order Pinales (or Coniferales) have been much discussed. Keng has considered the problem and has cited an extensive literature. The treatment of conifers and taxads presented by D. W. Bierhorst (*Morphology of Vascular Plants*, 429-464. 1971) is highly informative in matters of detail.

KEY TO FAMILIES OCCURRING IN FIJI

Seeds solitary, often enclosed partially or wholly in a fleshy epimatium and becoming drupelike; leaves spirally arranged or distichous, less often acicular or scalelike. 2. PODOCARPACEAE

Seeds 1-many, subtended by a woody cone scale, these aggregated into usually dry and woody cones.

Each cone scale bearing 1 or less commonly 2 ovules, these sometimes adnate to its upper surface; leaves opposite or spirally arranged, broad or acicular and compressed. 3. ARAUCARIACEAE

Each cone scale bearing 2 or more free ovules on its upper surface.

Leaves needle-shaped (in our genus) and in bundles, spirally arranged; cone scales spirally arranged, free, each with 2 winged seeds. 4. PINACEAE

Leaves decussate or 3- or 4-verticillate, mostly scalelike or acicular; cone scales decussate or verticillate, these and the bracts completely fused, the seeds exalate or 2- or 3-winged. 5. CUPRESSACEAE

FAMILY 2. PODOCARPACEAE

PODOCARPACEAE Endl. Syn. Conifer. 203, as *Podocarpeae*. 1847.

Diocious or rarely monoecious trees or shrubs; leaves spirally arranged or distichous, sessile or short-petiolate, sometimes acicular or scalelike; pollen cones terminal on leafy shoots or axillary, usually with numerous stamens (microsporophylls) on an elongate axis; seed cones with 1-many scales, 1-3 of these being fertile (megasporephylls); fertile scales bearing a single ovule (megasporangium), this ebracteate or more or less enveloped by an excrescence of the scale (epimatium) or rarely by the scale itself; cotyledons 2.

DISTRIBUTION: Twelve genera and 125 or more species, primarily of the Southern Hemisphere but extending northward to Japan, Central America, and the West Indies. Most genera are tropical and some are endemic to the tropics.

USEFUL TREATMENTS OF FAMILY: Pilger, R. *Taxaceae*. *Pflanzenr.* 18 (IV. 5): 1-124. 1903. Laubenfels, D.J. de. A revision of the Malesian and Pacific rainforest conifers, I. *Podocarpaceae*, in part. *J. Arnold Arb.* 50: 274-369. 1969. Laubenfels, D.J. de. *Podocarpaceae*. Aubréville & Leroy, *Fl. Nouv. Caléd. et Dépend.* 4: 15-79. 1972.

This well differentiated family is distinguished by such characters as having a single wingless seed per fertile scale, by having two sporangia per microsporophyll, and by having two cotyledons, in addition to having unique anatomical and embryonic characters (cf. de Laubenfels, 1969, cited above). The seed-bearing structures in many genera are highly modified from cone morphology, but the pollen cones are always truly conelike. The present treatment of most genera is adapted from the 1969 paper of de Laubenfels.

KEY TO GENERA

- Seed free, projecting above an epimatium (fertile scale); seed structures terminal on ordinary foliage branches; leaves crowded, awl-like, linear, or scalelike. 1. *Dacrydium*
- Seed covered by or fused with the scale.
 - Fertile bract forming a terminal crest over seed complex; leaves awl-like. 2. *Dacrycarpus*
 - Fertile bract separate from seed complex; leaves flat.
 - Seed complex becoming erect; leaves bilaterally flattened. 3. *Acmopyle*
 - Seed complex remaining inverted; leaves bifacially flattened.
 - Fertile shoot scaly; leaves with hypoderm, usually amphistomic and decussate, lanceolate. 4. *Decussocarpus*
 - Fertile shoot divided into a naked peduncle and a specialized fleshy receptacle; leaves with both hypoderm and accessory transfusion tissue. 5. *Podocarpus*

1. *DACRYDIUM* Soland. ex Forst. f. *Pl. Esc. Ins. Oc. Austr.* 80, nom. nud. 1786; Soland. ex Lamb. *Descr. Gen. Pinus* 1: App. 93. 1807; Seem. *Fl. Vit.* 267. 1868; Pilger in *Pflanzenr.* 18 (IV. 5): 43. 1903, in Engl. & Prantl, *Nat. Pflanzenfam.* ed. 2. 13: 239. 1926; A. C. Sm. in *J. Arnold Arb.* 36: 274. 1955; de Laubenfels in op. cit. 50: 282. 1969.

Trees (our species); juvenile leaves awl-shaped falcate needles, longer than the adult leaves; adult leaves (in our species) small, spreading or obliquely ascending, acute, dorsally carinate, crowded; pollen cones cylindric, terminal or lateral; seed cones much reduced, with bracts hardly modified from foliage leaves, often becoming fleshy when ripe, terminal, often on short lateral branches; ovules inverted on bracts in a nearly terminal position and partly covered by an epimatium; seeds usually becoming erect, projecting beyond apex of the modified cone, in our species 3.5-4 mm. long, oval, the micropyle forming a small tip.

TYPE SPECIES: *Dacrydium cupressinum* Soland. ex Lamb.

DISTRIBUTION: De Laubenfels recognizes 15 species, occurring from southeastern Asia through Malesia and the Philippines to the Solomon Islands, New Caledonia, and Fiji, where the range terminates with two species, of which one is endemic.

KEY TO SPECIES

- Change between juvenile and adult leaves abrupt, the latter minute, not more than 2 mm. long; pollen cones to 2.5 mm. long. 1. *D. nausoriense*
 Change between juvenile and adult leaves gradual, the latter 2–7 mm. long; pollen cones 9–12 mm. long. 2. *D. nidulum*

1. ***Dacrydium nausoriense*** de Laubenfels in J. Arnold Arb. **50**: 287. fig. 1, a, as *D. nausoriensis*. 1969; J. W. Parham, Pl. Fiji Isl. ed. 2. 72, as *D. nausoriensis*. 1972; A. C. Sm. in Allertonia **1**: 332. 1978. FIGURE 31A.

This recently recognized species is a tree 12–24 m. high in adult foliage, occurring in usually dense forest at elevations of 180–600 m. Its fruits are purplish or brownish, becoming black at full maturity. In the available material immature inflorescences have been observed in May and October and fruits between February and October.

TIPIFICATION: The holotype is *de Laubenfels P302* (A), collected in the Nausori Highlands 4 miles southeast of Nausori, Nandronga & Navosa Province, Viti Levu; there are several isotypes.

DISTRIBUTION: Endemic to Fiji. As noted by me in 1978, *Dacrydium nausoriense* has a very restricted distribution, occurring only in the Nausori Highlands, a region of western Viti Levu lying mostly in Nandronga & Navosa Province but in lesser part in Mba Province. Its occurrence on Vanua Levu, noted by de Laubenfels, appears to have been based on faulty records. It is abundant in its limited area, from which I have examined 23 collections.

LOCAL NAMES AND USES: Both species of *Dacrydium* occurring in Fiji are known as *yaka* and *tangitangi*, and both are considered valuable timber trees, being used primarily for furniture.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Western slopes of Mt. Mangondro, *Webster & Hildreth 14278*, NANDRONGA & NAVOSA: Nausori Highlands, *Johns 2*, *DF 832*, *1146* (*S1419/7*), *S1419/3* (*NH/23*), *S1419/6* (*NH/50*), *DA 13314*, *13326*, *15272*, *15620*, *O. & I. Degener 32159*, *de Laubenfels P303*, *P304*.

2. ***Dacrydium nidulum*** de Laubenfels in J. Arnold Arb. **50**: 292. 1969. FIGURE 31B–D.

Dacrydium elatum sensu Seem. in Bonplandia **9**: 259. 1861, in op. cit. **10**: 297. 1862, Viti, 442. 1862, Fl. Vit. 267. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 352. 1892; Pilger in Pflanzenr. **18** (IV. 5): 51, p. p. 1903; A. C. Sm. in J. Arnold Arb. **36**: 274. 1955; J. W. Parham, Pl. Fiji Isl. **43**. fig. 21. 1964; non Wall. *Dacrydium lycopodioides* sensu A. C. Sm. in Bishop Mus. Bull. **141**: 11. 1936, in Bull. Torrey Bot. Club **70**: 533. 1943, in J. Arnold Arb. **36**: 274. 1955; J. W. Parham, Pl. Fiji Isl. **43**. 1964; non Brongn. & Gris.

The more common *Dacrydium* in Fiji is a tree 6–35 m. high in adult foliage, with a mature trunk diameter of 1–2 m., occurring in various types of forest, often dense or comparatively dry, at elevations from near sea level to 1,120 m. Its fruits are at first light green but become brown at maturity. Immature cones and fruits have been collected between March and July. Only var. *nidulum* occurs in Fiji (de Laubenfels in J. Arnold Arb. **50**: 292, fig. 3, a. 1969; J. W. Parham, Pl. Fiji Isl. ed. 2. 72. fig. 21. 1972).

TIPIFICATION AND NOMENCLATURE: The holotype is *Vink BW15271* (L), collected at Segior (L. Ajamaru), Vogelkop, West New Guinea; there are several isotypes. Prior to the 1969 revision by de Laubenfels the nomenclature of this species was misunderstood. The presence of two species in Fiji had been suspected, but these are

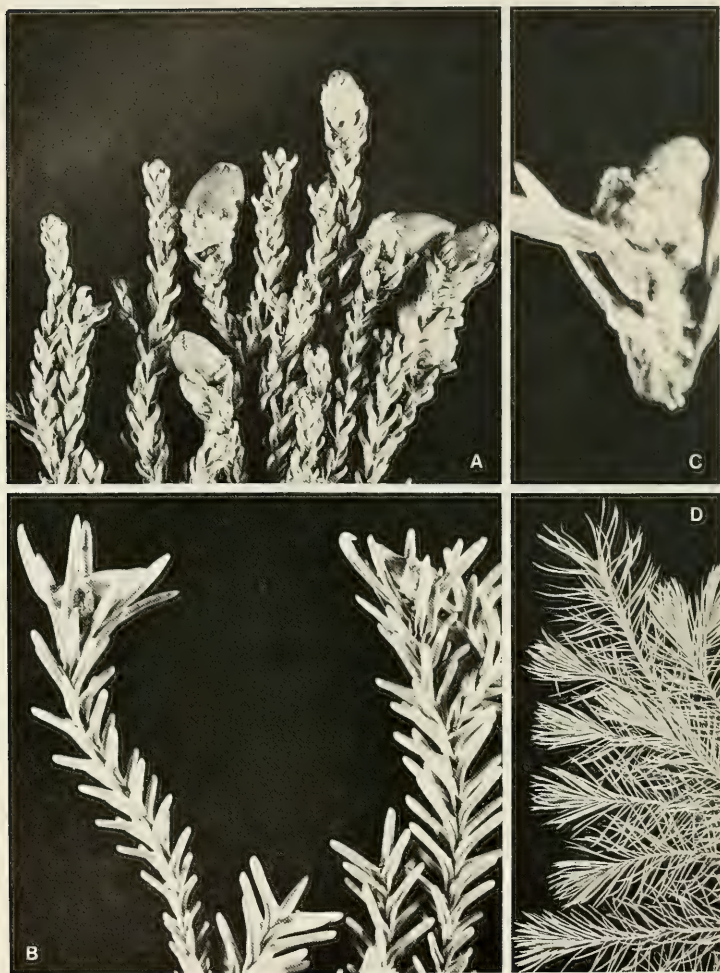


FIGURE 31. A, *Dacrydium nausoriense*, tips of branchlets and seed cones, $\times 4$, from DA 13314. B-D, *Dacrydium nidulum* var. *nidulum*; B, tips of branchlets and seed cones, $\times 4$; C, seed cone, with some bracts removed, $\times 10$; D, juvenile foliage, $\times 1$; B & C from Gillespie 2309, D from de Laubenfels P307.

now seen to be immature and mature stages of *Dacrydium nidulum*. *Dacrydium elatum* (Roxb.) Wall. does not occur east of Borneo, while *D. lycopodioides* Brongn. & Gris is endemic to New Caledonia. At the time of most of the above cited mis-identifications, the second Fijian species, *D. nausoriense*, had not even been collected. A second variety of *D. nidulum* occurs only in New Guinea.

DISTRIBUTION: Celebes, Halmahera, New Guinea, and Fiji. It is most abundant in New Guinea but has not been collected in the Solomons or New Hebrides. In Fiji it is known from Viti Levu (but not from the area of the Nausori Highlands), Kandavu, Ovalau, and Vanua Levu, being common in some areas. Approximately 70 collections have been examined.

LOCAL NAMES AND USES: *Yaka* and *tangitangi* are commonly used; apparently the name *leweninini* is sometimes used for the immature stage. Seemann (in 1868, cited above) mentions a misuse of *ndakua salusalu* for *Dacrydium*, but that name invariably is associated with *Decussocarpus vitiensis*. *Dacrydium nidulum* is regarded as a valuable timber tree in Fiji, being considered excellent for furniture.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MRA: Hills east of Nandala Creek, south of Nandarivatu, *Smith* 6244. SERUA: North of Namboutini, *DF* 834 (*SI*1419/5), *de Laubenfels* P307. NAMOSI: Track to Mt. Nambui, Korombasambasanga Range, *DA* 14544; Mt. Voma (on K sheet, but "Ovalau" in Fl Vit.), *Seemann* 573. RA: Ridge from Mt. Namama (east of Nandarivatu) toward Mt. Tomanivi, *Smith* 5734. NAITASIRE: Nambukaluka, Waindina River, *DA* 27; Waimanu River, *DA* 15645; Tholo-i-suva, *DA* 10984; vicinity of Tamavua, *Gillespie* 2142. REWA: Mt. Korombamba, *Gillespie* 2309, *Meebold* 16529; Wailoku, *de Laubenfels* P312. VITI LEVU without further locality, *Milne* 294, *Graeffe* 23. KANDAVU: Naikoro-koro, *FD* 364. OVALAU: *Milne* 55; Mbureta River, *Storck* 906. VANUA LEVU: MATHUATA: Near Ndreketi, *DA* 12863; Nanduri, *Tothill* 553; Mt. Ndelaikoro, *DA* 12823. THAKAUNDROVE: Mt. Kasi, Yanawai River region, *Smith* 1773.

2. *DACRYCARPUS* de Laubenfels in J. Arnold Arb. 50: 315. 1969.

Podocarpus sect. *Dacrycarpus* Endl. Syn. Conifer. 221. 1847; Wasscher in *Blumea* 4: 386. 1941; Buchh. & N. E. Gray in J. Arnold Arb. 29: 56. 1948.

Trees (our species) with small, alternate, scalelike, awl-shaped leaves, these distinctly bilaterally flattened in juvenile stage; pollen cones cylindric, terminal on short lateral twigs with long apiculate sporophylls resembling leaves, with 2 sporangia; seed cones terminal on lateral twigs with 1 or 2 inverted ovules (usually only 1 developing into a seed), the bract adherent to and as long as the ovule, forming a projected crest, becoming consolidated with epimatium throughout its length, the cone axis and sterile bracts below seeds usually becoming warty and fleshy.

TYPE SPECIES: *Dacrycarpus imbricatus* (Bl.) de Laubenfels (*Podocarpus imbricatus* Bl.)

DISTRIBUTION: Nine species are included by de Laubenfels, occurring from Burma throughout Malesia to New Caledonia, New Zealand, and Fiji, where the generic range terminates, a single species being present in Fiji.

1. *Dacrycarpus imbricatus* var. *patulus* de Laubenfels in J. Arnold Arb. 50: 320. fig. 8, b. 1969; J. W. Parham, Pl. Fiji Isl. ed. 2. 72. 1972. FIGURE 32.

Podocarpus cupressina sensu Seem. Viti, 442. 1862, Fl. Vit. 267. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 352. 1892; non R. Br. ex Horsfield.

Podocarpus imbricata sensu Gibbs in J. Linn. Soc. Bot. 39: 182. 1909; Wasscher in *Blumea* 4: 388, p. p. 1941; non Bl.

Podocarpus imbricatus sensu J. W. Parham, Pl. Fiji Isl. 43. 1964; non Bl.

The only representative variety of *Dacrycarpus* occurring in Fiji is a tree 8–24 m. high, with a mature trunk diameter up to 1 m., occurring in dense, dry, or secondary forest at elevations from near sea level to 1,100 m. Its fruits are at first green, becoming orange-red or purplish at maturity. Mature fruits have been collected between



FIGURE 32. *Dacrycarpus imbricatus* var. *patulus*; A, tips of branchlets and seed cones, $\times 2$, from DF 852; B, pollen cone, $\times 10$, from DF 521.

September and March. In taking up the name *D. imbricatus* (Bl.) de Laubenfels (based on *Podocarpus imbricata* Bl. Enum. Pl. Javae, 89. 1827), the author divided it into four varieties, of which two were described as new.

TYPEIFICATION: As lectotype of the species and its var. *imbricatus*, de Laubenfels has indicated *Blume s. n.* (L). The holotype of var. *patulus* is *de Laubenfels P328* (A), collected at Nandarivatu, Mba Province, Viti Levu, Fiji; isotypes are available at K and SUVA.

DISTRIBUTION: In the inclusive sense, *Dacrycarpus imbricatus* has a distribution extending from southeastern Asia throughout Malesia, including the Philippines, to the New Hebrides and Fiji. The typical variety, however, occurs only in Malesia, from Java to Celebes. Variety *patulus* has a broader distribution, according to de Laubenfels, extending from Burma, southern China, and Hainan to the Philippines, New Hebrides, and Fiji, where it is known definitely only from the two largest islands. The other two varieties have more limited distributions, as indicated by de Laubenfels's citations and his maps (1969, cited above, p. 319). Approximately 50 Fijian collections of var. *patulus* have been examined.

LOCAL NAMES AND USE: *Amunu* and *aumunu* are the most commonly used Fijian names, but the plant has also been indicated as *kautambua*, *kausola*, *salusahu*, and *ndakua salusahu*. Although the last has been recorded several times for the present plant, it is universally applied in Fiji to *Decussocarpus vitiensis*. *Kau tambua* was the name recorded by Seemann for the Fijian *Dacrycarpus*, presumably because the timber has the yellowish tinge of a well-oiled whale's tooth (*tambua*). The present taxon is considered one of the most important timber trees of Fiji.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Vicinity of Nandarivatu, Gibbs 775A (& B), Vaughan 3258, de Laubenfels P331; hills east of Nandala Creek, Smith 6245; ridge near Navai, DA 2094. NANDRONGA & NAVOSA: Nausori Highlands, DF 854 (SI426/3), de Laubenfels P306. SERUA: Mt. Tikituru, DA 14470; inland from Namboutini, DF 852 (SI426/1), de Laubenfels P310. NAMOSI: Milne s. n.; Nanggarawai, DA 1398; Nambukavesi, DF 770 (SI426/5). NAITASIRI: Waimanu River, DA L. 13240; Tholo-i-suva, DA 12427 (DF 72; Watkins 736); Nanduruloulou, DA 10847. VITI LEVU without further locality, Milne 31. VANUA LEVU: MATHUATA: Inland from Ndreketi River, DF 521, 856 (SI426/4).

De Laubenfels indicates that the four varieties of *Dacrycarpus imbricatus* are separable on characters of the mature foliage leaves, those of var. *patulus* being spreading (rather than imbricate), 0.8–1.5 mm. long, and 0.4–0.6 mm. broad; the involucre leaves are 1–3 mm. broad rather than 2–4 mm., as in var. *imbricatus*.

3. *ACMOPYLE* Pilger in Pflanz. 18 (IV. 5): 117. 1903, in Engl. & Prantl, Nat. Pflanz. fam. ed. 2. 13: 240. 1926; Buchh. & N.E. Gray in J. Arnold Arb. 28: 141. 1947; A.C. Sm. in op. cit. 36: 274. 1955; de Laubenfels in op. cit. 50: 337. 1969.

Small trees; foliage leaves linear, bilaterally flattened, distichous, sometimes marginally revolute; leaves on non-foliage branches (fertile shoots and branches of the second order) scalelike, deltoid, bifacially flattened; pollen cones terminal and lateral; seed cones on short branches, these lateral or terminal or grouped together, the cones becoming enlarged and warty as a receptacle with a single subterminal seed, the ovule at first inverted and partially covered by the epimatium, eventually becoming nearly erect, fused with the epimatium, and fleshy.

TYPE SPECIES: *Acropyle pancheri* (Brongn. & Gris) Pilger (*Dacrydium pancheri* Brongn. & Gris).

DISTRIBUTION: Only two species are known, one endemic to New Caledonia and the other to Fiji.

USEFUL TREATMENT OF GENUS: Buchholz, J.T., & N.E. Gray. A Fijian *Acropyle*. J. Arnold Arb. 28: 141–143. 1947.

This very distinct genus is characterized by having the seed fused with the epimatium and an inverted ovule, which gradually becomes nearly erect as it matures. The other genera of Podocarpaceae which have seeds fused with the epimatium lack these erect seeds. The bilaterally flattened and distichous leaves are also unusual, but they do occur in *Falcatifolium* de Laubenfels and in juvenile forms of *Dacrycarpus*. Buchholz and Gray mention that Sahni (in Philos. Trans. Ser. B. 210: 253–310. 1920) had expressed the opinion that a Fijian specimen collected by Horne represented the genus (then known only from the New Caledonian species); this opinion is now documented.

1. *Acropyle sahniana* Buchh. & N.E. Gray in J. Arnold Arb. 28: 142. pl. I, A. 1947; A.C. Sm. in op. cit. 36: 274. 1955; J.W. Parham, Pl. Fiji Isl. 43. 1964, ed. 2. 72. 1972; de Laubenfels in J. Arnold Arb. 50: 340. 1969. FIGURE 33.

Acropyle sp. Sahni in Philos. Trans. Ser. B. 210: 256. 1920.



FIGURE 33. *Acropyle sahniana*; A, terminal branchlet with two seed cones, $\times 1$; B, pollen cone, $\times 10$; C, seed cone, $\times 10$; A & C from DA 16138, B from Smith 4122.

The remarkable Fijian species of *Acropyle* is a tree 3–8 m. high, becoming gnarled at higher elevations, occurring at altitudes of 670–1,050 m. in dense forest or in low dense forest on ridges. The young cones are green, becoming black, and have been collected only in November, doubtless a reflection on the rarity of the taxon.

TYPEFICATION: The holotype is Gillespie 3273 (A), a sterile specimen collected Oct. 2, 1927, on an exposed ridge near the summit of Mt. Vakarongasiu (summit elevation 863 m.), Namosi Province, Viti Levu; isotypes are at BISH and K.

DISTRIBUTION: Endemic to Fiji and known from only six collections, probably all from Viti Levu.

LOCAL NAMES: *Nggamleve* (possibly a fictitious name applied humorously to Smith 4122); *kau tambua* (on Horne label, but he may have taken the name from Seemann's treatment of the preceding species).

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Eastern slopes of Mt. Koroyanitu, Mt. Evans Range, Smith 4122. NAMOSI: Upper slopes and summit of Mt. Vakarongasiu, DA 14598, 16138, L.26188. FIJI without further locality, Horne s. n. Horne did not reach either of the two localities known for this rare species, but he did collect in the rugged areas north of the Navua River, not far to the west of Mt. Vakarongasiu.

4. *Decussocarpus* de Laubenfels in J. Arnold Arb. **50**: 340. 1969.

Podocarpus sect. *Polypodiopsis* Bertrand in Ann. Sci. Nat. Bot. V. **20**: 65. 1874; Florin in Kongl. Svenska Vetenskapsakad. Handl. III. **10**: 275. 1931; Wasscher in Blumea **4**: 423. 1941; Buchh. & N. E. Gray in J. Arnold Arb. **29**: 57. 1948; N. E. Gray in op. cit. **43**: 67. 1962.

Dioecious trees; leaves small, opposite, decussately or spirally inserted, lanceolate or rounded, contracted at base, 1-many-nerved (1-nerved in our species); pollen cones cylindric, 1-several terminating a special axillary branch with opposite pairs of scale leaves; seed cone terminal on an axillary branch, bearing terminally a single inverted ovule free from a small subtending bract, the epimatium fused with and completely surrounding ovule and seed as part of a fleshy layer, the sterile bracts of cone axis below seed scalelike and decussate; seed large, slightly elongated or pear-shaped.

TYPE SPECIES: *Decussocarpus vitiensis* (Seem.) de Laubenfels (*Podocarpus vitiensis* Seem.).

DISTRIBUTION: Twelve species are recognized by de Laubenfels, distributed in Africa (sect. *Afrocarpus*) and from India, China, and Japan through Malesia to New Caledonia and Fiji, with one species (of sect. *Decussocarpus*) in America from Colombia and Venezuela to Peru.

USEFUL TREATMENTS OF GENUS (sect. *Decussocarpus* only): Gray, N. E., & J. T. Buchholz. A taxonomic revision of *Podocarpus*, III. The American species of *Podocarpus*: section *Polypodiopsis*. J. Arnold Arb. **29**: 117-122. 1948. Gray, N. E. A taxonomic revision of *Podocarpus*, XIII. Section *Polypodiopsis* in the South Pacific. Op. cit. **43**: 67-79. 1962.

In proposing *Decussocarpus* as a new genus, de Laubenfels combined three sections that formerly had been treated as parts of *Podocarpus*. The characters that separate these taxa from *Podocarpus* are discussed in detail by de Laubenfels. Section *Decussocarpus* (*Podocarpus* sect. *Polypodiopsis*) is the only section that occurs in Fiji; it contains four species. A second section *Dammaroides* (Bennett ex Horsfield) de Laubenfels includes five species, and a third section *Afrocarpus* (Buchh. & N. E. Gray) de Laubenfels includes three species (although N. E. Gray, in J. Arnold Arb. **34**: 67-76. 1953, considered *Podocarpus* sect. *Afrocarpus* to include six species). Since only the first of these sections is pertinent to the present treatment, the literature concerning the other two is not here detailed. Section *Decussocarpus* is readily recognized by its single-veined but relatively broad leaves; sect. *Afrocarpus* has leaves more than ten times as long as broad; and sect. *Dammaroides* has broad, multiveined leaves.

1. *Decussocarpus vitiensis* (Seem.) de Laubenfels in J. Arnold Arb. **50**: 342. 1969; J. W. Parham, Pl. Fiji Isl. ed. 2. *fig.* 22. 1972. FIGURE 34.

Podocarpus ? v. gen. nov. Seem. in Bonplandia **9**: 259. 1861, Viti, 442. 1862.

Podocarpus vitiensis Seem. in Bonplandia **10**: 366. 1862, in J. Bot. **1**: 33. *pl.* 2. 1863, Fl. Vit. 266. *pl.* 77. 1868; v. Tiegh. in Bull. Soc. Bot. France **38**: 169. 1891; Drake, Ill. Fl. Ins. Mar. Pac. 353. 1892; Pilger in Pflanzenr. **18** (IV. 5): 63. 1903; Gibbs in J. Linn. Soc. Bot. **39**: 182. 1909, in Ann. Bot. **26**: 533. 1912; Dallimore & Jackson, Handb. Conif. 58. 1923; Pilger in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. **13**: 245. 1926; Florin in Kongl. Svenska Vetenskapsakad. Handl. III. **10**: 275. 1931; Wasscher in Blumea **4**: 425. 1941; N. E. Gray in J. Arnold Arb. **43**: 72. 1962; J. W. Parham, Pl. Fiji Isl. *fig.* 22. 1964; de Laubenfels in Blumea **15**: 440. 1967.

Podocarpus filicifolius N. E. Gray in J. Arnold Arb. **43**: 74, p. p. 1962.

In Fiji the single species of *Decussocarpus* is a large tree 10-30 (-43) m. high, with a straight trunk often exceeding 1 m. in diameter, occurring in usually dense forest or ridge forest at elevations from near sea level to 915 m. The fruit is brown or purple at maturity. Pollen cones have been collected between March and December and fruits between June and February.

LECTOTYPIFICATION AND NOMENCLATURE: In first describing *Podocarpus vitiensis* in 1862, Seemann cited his own 576 and a Milne collection. Although N.E. Gray (1962, cited above) and de Laubenfels (1969, cited above) indicated *Seemann 576* (K) as the holotype, this is not quite the case, however logical their indication. *Seemann 576* (K) is herewith designated as the lectotype; it was collected in July, 1860, and therefore was obtained in southeastern Viti Levu. Isolectotypes have been seen at A and BM. The holotype of *P. filicifolius* was collected by *Kostermans* (L) in 1949, on Morotai in the Moluccas. De Laubenfels has indicated that the specimen is accompanied by an alien seed which doubtless caused Gray to misinterpret it.

DISTRIBUTION: Long considered a Fijian endemic, *Decussocarpus vitiensis* is now known to occur in a discontinuous series of localities from the Moluccas, New Guinea, New Britain, the Santa Cruz Islands, and Fiji. In the last archipelago it may be considered fairly abundant, more than 50 collections being at hand from the islands of Viti Levu, Kandavu, and Vanua Levu.



FIGURE 34. *Decussocarpus vitiensis*; A, terminal branchlet with mature seed cones, $\times 1$, from Gillespie 3865; B, apical portion of pollen cone, $\times 10$, from Parks 20653.

LOCAL NAMES AND USES: In Fiji this taxon is universally known as *ndakua salu-salu*, rarely merely as *salusalu*. In his earliest mentions, Seemann used the name *kau solo*, but presumably his informants confused the tree with the Fijian *Dacrycarpus*. *Decussocarpus vitiensis* is one of the most highly valued trees of Fiji, perhaps second only to *Agathis vitiensis* in esteem; it is considered to produce an excellent wood for furniture, interior finishing, etc. The inflammable resin of the trunk, like that of the *Agathis*, is used by Fijians to start fires.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Western slopes of Mt. Mangondro, *Webster & Hildreth 14277*; Koro-O, west of Nandarivatu, *Berry 110*; vicinity of Nandarivatu, *Gibbs 674*, *Parks 20653*, *Gillespie 3865*; Mt. Nanggaranambuluta, east of Nandarivatu, *Vaughan 3254*; Navai Valley, *DA 2292*. SERUA: Navutulevu Creek, *DF 680 (SI413/3)*; inland from Namboutini, *de Laubenfels P309*; north of Ngaloa, *DF 582 or 806 (SI413/6)*. NAMOSI: Nambukavesi Creek, *DF 537*. NAITASIRI: Navolau, *DA 636*; Waimanu River, *DA L.13241 (Berry 47)*. TAILEVU: Waindina Falls, *DA 139*; hills east of Wainimbuka River, vicinity of Ndakuivuna, *Smith 7076*. KANDAVU: Naikorokoro, *DF 751 (KU 22)*, *DA 13775*. VANUA LEVU: THAKAUNDROVE: Thongea, Wainunu River, *DA 3752*; Mt. Kasi, Yanawai River region, *Smith 1796*; Nayarambale and Nakarambo, *DA 3751*, FIJI without further locality, *Milne 33, s. n.*, *Graeffe 1*, *Horne 531*.

5. *PODOCARPUS* L'Hér. ex Pers. Syn. Pl. 2: 580. 1807; Seem. Fl. Vit. 266, p. p. 1868; Pilger in Pflanzenr. 18 (IV. 5): 54, p. p. 1903, in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. 13: 240, p. p. 1926; Wasscher in Blumea 4: 360, p. p. 1941; Buchh. & N. E. Gray in J. Arnold Arb. 29: 54, p. p. 1948. Nom. cons.

Podocarpus sect. *Eupodocarpus* Endl. Syn. Conifer. 208. 1847; Pilger in Pflanzenr. 18 (IV. 5): 73. 1903; Wasscher in Blumea 4: 427. 1941; Buchh. & N. E. Gray in J. Arnold Arb. 29: 58. 1948.

Podocarpus sect. *Eupodocarpus* subsect. *F* N. E. Gray in J. Arnold Arb. 36: 199. 1955.

Podocarpus sect. *Podocarpus* subsect. *B* N. E. Gray in J. Arnold Arb. 39: 424. 1958.

Usually dioecious trees and shrubs; leaves alternate, flat, arising from all sides of twig; pollen cones axillary, single or grouped or variously clustered on peduncles; seed cones borne singly on axillary peduncles bearing 1 or 2 terminal inverted ovules, these surrounded by the epimatium, their subtending bracts separate and small, usually included in cone axis, this (with sterile bracts) becoming a swollen or fleshy receptacle; seeds mostly ovoid or globose, frequently with an apiculus at the exposed end.

TYPE SPECIES: *Podocarpus elongatus* (Ait.) L'Hér. ex Pers. (*Taxus elongata* Ait.). Typ. cons.

DISTRIBUTION: *Podocarpus*, in the limited sense here accepted, has 75 or more species distributed in three widely separated areas: (1) Nepal, China, and southern Japan through Malesia, including the Philippines, southward to Tasmania and New Zealand, and eastward to Fiji and Tonga; (2) southern Africa and Madagascar; and (3) South and Central America and the West Indies. Buchholz and Gray have treated *Podocarpus* sect. *Podocarpus* (called sect. *Eupodocarpus* in their earlier papers) as composed of six subsections (unnamed but lettered A–F). The type species, the African *P. elongatus*, falls into their subsect. A (cf. J. Arnold Arb. 34: 163–167. 1953).

USEFUL TREATMENTS OF GENUS: Gray, N. E. A taxonomic revision of *Podocarpus*, IX. The South Pacific species of section *Eupodocarpus*, subsection F. J. Arnold Arb. 36: 199–206. 1955. Gray, N. E. A taxonomic revision of *Podocarpus*, XI. The South Pacific species of section *Podocarpus*, subsection B. Op. cit. 39: 424–477. 1958.

Three species are recognized as occurring in Fiji by N. E. Gray: *Podocarpus neriifolius* (with two varieties) and *P. affinis* of subsect. B and *P. decipiens* of subsect. F. Therefore treatments of other subsections by Buchholz and Gray (or by Gray alone) are not listed above. The sole indigenous Tongan species of *Podocar-*

pus, *P. pallidus* N.E. Gray (in Bishop Mus. Bull. 220: 46. fig. 6. 1959) also falls into subsect. *F*, being most closely related to *P. decipiens*. Among the Fijian species, *P. affinis* is readily distinguishable without recourse to anatomical characters of the leaf; Buchholz and Gray largely utilized such characters, which are scarcely practicable for identification in the field or herbarium. Without resorting to such characters, *P. neriifolius* (with two varieties) and *P. decipiens* are separable with difficulty; they have similar local distributions and habitats (often growing near streams and dipping into them), and altitudinal differences are inconsequential. Nevertheless I have here attempted to distinguish the species according to the criteria of Buchholz and Gray.

It should be noted that Wasscher (1941, cited above) uses *Podocarpus* as a feminine noun, as did L'Héritier and some other authors. However, most authors have considered it masculine and it is conserved as such in the ICBN.

KEY TO SPECIES

Resin canals lacking above the vascular bundle of leaf, the midrib narrow and often abruptly prominent above, broad and prominent beneath (subsect. *B*).

Leaves narrowly linear-elliptic, 30–60 (–65) × 6–11 mm., rounded or obtuse at apex. 1. *P. affinis*

Leaves narrowly lanceolate or linear-oblong, 60–150 × 6–13 mm. or larger, gradually narrowed to an acute apex. 2. *P. neriifolius*

Resin canals 2 or more above the vascular bundle of leaf; leaves linear-lanceolate, 63–130 × 7–16 mm. (to 230 × 23 mm. on young, sterile plants), the midrib broad, only slightly prominent (subsect. *F*).

3. *P. decipiens*

1. ***Podocarpus affinis*** Seem. Fl. Vit. 266. 1868; Parlatore in DC. Prodr. 16 (2): 517. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 352. 1892; Pilger in Pflanzenr. 18 (IV. 5): 78. 1903; Dallimore & Jackson, Handb. Conif. 38. 1923; Pilger in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. 13: 248. 1926; N.E. Gray in J. Arnold Arb. 39: 445. 1958; J. W. Parham, Pl. Fiji Isl. 43. 1964, ed. 2. 72. 1972. FIGURE 35.

Podocarpus (elatus ?) sensu Seem. in Bonplandia 9: 259. 1861, Viti, 442. 1862; non R. Br.

This well-marked endemic *Podocarpus*, readily recognized by its comparatively small and blunt leaves, is a tree 3–9 m. high, found in the dense forest of crests and summits at altitudes of 600–960 m. It has been infrequently collected in fertile condition, but pollen cones have been obtained in November and fruits in August and November.

TYPE: The type, which is sterile, is *Seemann 574* (K HOLOTYPE; ISOTYPE at BM), collected Aug. 24, 1860, on the summit of Mt. Voma (elevation 923 m.), Namosi Province, Viti Levu.

DISTRIBUTION: Endemic, and apparently limited to high crests and peaks on Viti Levu; according to Seemann it forms the principal part of the vegetation of the summit of Mt. Voma (a fact borne out by the considerable number of more recent collections made there). I have seen 19 collections, all of which are here listed.

LOCAL NAMES AND USES: *Kuasi* is the usual Fijian name, as for other species of *Podocarpus*; *kasi* has also been recorded. In his first edition Parham noted the name *mbaukiwangga* and indicated the species as a fairly common useful timber tree, both statements being misinformation doubtless suggested by Seemann's dubious note: "The natives use the wood for outriggers of canoes." It is unlikely that this rare and small tree has any local uses.

AVAILABLE COLLECTIONS: VITI LEVU: MBA or NAITASIRI: Track between Navai and Nasonggo, DA 15303, 15304. NANDRONGA & NAVOSA: Koronayalewa, DA 1420. NANDRONGA & NAVOSA–SERUA boundary: Near summit of Mt. Tuvutau, DA 14478. NAMOSI: Mt. Naitarandamu, Gillespie 3307.5; track to Mt.

Nambui, Korombasambasanga Range, DA 14547, 14553; upper slopes and summit of Mt. Voma, Gillespie 2669, 2721, DA 582, 1914, 3763, 5552, de Laubenfels P335, P336, de Laubenfels & Kuruvoli, Nov. 7, 1964. FIJI without further locality, Horne 762, 973.

2. *Podocarpus neriifolius* D. Don in Lamb. Descr. Gen. Pinus 2: 21, as *P. nereifolia*. 1824; Pilger in Pflanzenr. 18 (IV. 5): 80. 1903; J.W. Parham, Pl. Fiji Isl. 43. 1964.

Of this widespread *Podocarpus* five varieties are recognized by N.E. Gray (in J. Arnold Arb. 39: 460-469. 1958). Above are cited only those pertinent references in which varieties are not distinguished in the same manner.

KEY TO VARIETIES OCCURRING IN FIJI

- Leaves linear-oblong, 60-150 × 9-15 mm. or larger.2a. var. *neriifolius*
 Leaves narrowly linear, 60-120 × 6-10 mm. (on young shoots to 180 × 17 mm.).2b. var. *degeneri*



FIGURE 35. *Podocarpus affinis*, from DA 14547; A, terminal branchlet with seed cones, × 1; B, mature seed cones, × 4.



FIGURE 36. *Podocarpus neriifolius* var. *neriifolius*; A, terminal branchlet with pollen cones, $\times 1$, from DA 15577; B, terminal branchlet with seed cones, $\times 1$, from DA 12545.

2a. *Podocarpus neriifolius* var. *neriifolius*; J. W. Parham, Pl. Fiji Isl. ed. 2. 74. 1972.

FIGURES 36, 37, 38C.

Podocarpus bracteata Bl. Enum. Pl. Javae, 88. 1827; Seem. Fl. Vit. 266, p. p. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 352, p. p. 1892.

Podocarpus (polystachya ?) sensu Seem. in Bonplandia 9: 259, p. p. 1861, Viti, 442, p. p. 1862; non R. Br.

Podocarpus elata sensu Gibbs in J. Linn. Soc. Bot. 39: 183. 1909; non R. Br. ex Mirb.

Podocarpus neriifolius (sensu var. *neriifolius*) N. E. Gray in J. Arnold Arb. 39: 460. 1958.

The typical variety of *Podocarpus neriifolius* occurs in Fiji at elevations from near sea level to 1,100 m. as a tree 4–15 m. high, with an erect slender trunk and a freely branched crown. It is often locally abundant, growing in various types of forest or on its edges, in patches of forest in open country, often along rivers and streams. It may be found with pollen cones and seed cones throughout the year; the former are brown to yellow-green. The fruits have a red pedicel and at maturity are light blue to glaucous-gray and often waxy.

TYPIFICATION AND NOMENCLATURE: The holotype is *Wallich 6052* (κ) as originally labelled, but a notation "A" was later added; Gray did not cite this specimen but

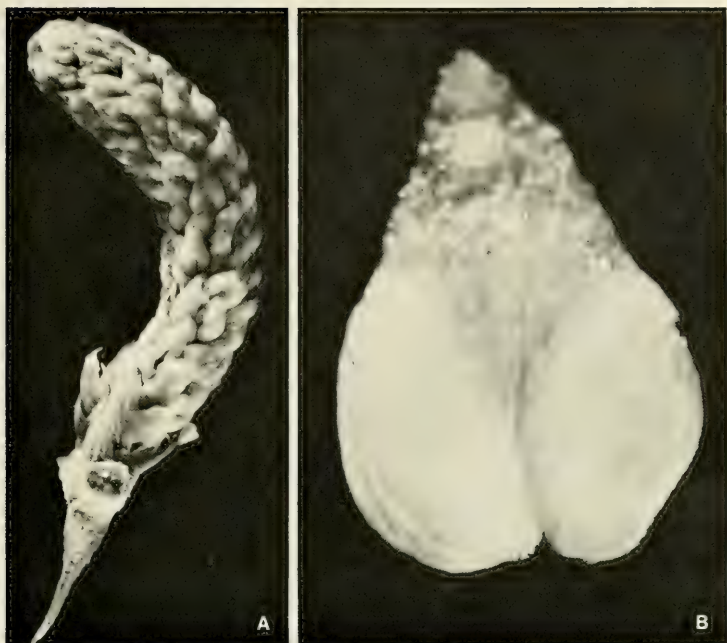


FIGURE 37. *Podocarpus neriifolius* var. *neriifolius*, from DA 15577; A, pollen cone, $\times 6$; B, abaxial (dorsal) surface of microsporophyll, $\times 50$.

only the isotypes at BM, BR, NY, and P. The collection comes from Nepal without further indication, and it is generally accepted that Wallich's first set is at K. The type of *Podocarpus bracteata* is Blume s. n. (L); it is placed in this typical variety of *P. neriifolius* by Gray.

DISTRIBUTION: *Podocarpus neriifolius* var. *neriifolius* has a greater geographic range than any other species of the genus. It occurs from India, China, and Japan through southeastern Asia to the Solomon Islands and Fiji. I have examined nearly 70 Fijian specimens which, according to Gray's criteria, seem to represent this typical variety.

LOCAL NAMES AND USES: The taxon has many Fijian names, the most usual being *kuasi* and *asimbolo*; also recorded are *kasi*, *ngalingali*, *asi*, *yasiyasi* (dubious, because this usually refers to Myrtaceae), and *mbaikiwangga* or *mbaukiwangga* (correctly referred here and not to *Podocarpus affinis*). The plant is regarded as a good timber tree, being used primarily for furniture and interior finishing; the trunks are used to fashion spears, and the wood is also used for dugout canoes, light poles, etc.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Mountains near Lautoka, *Greenwood* 50; Ndelai-O, Tavua, *de Laubenfels* P324; Koro-O, west of Nandarivatu, *Berry* 831; vicinity of Nandarivatu, *Gibbs* 819, *DA* 12545; Mt. Nanggaranambuluta, *Tothill* 842; Sovutawambu, *Degener* 14670. SERUA: Navua River below Nambukelevu, *DA* L.13352; Namboutini, *de Laubenfels* P311; Ndeumba, *DA* 13776 (*DF* 182). NAMOSI: Mt. Naitarandamu, *Gillespie* 3363; Mt. Voma, *de Laubenfels* P337. NAITASIRI: Waimanu River, *DA* 15577; Tholo-i-suva, *DA* 10987; vicinity of Tamavua, *Gillespie* 2143. TAILEVU: Near Naivithula, *Hotta* 3342. REWA: Namboro, *DA* 5937; Mt. Korombamba, *H. B. R. Parham* 92. VITI LEVU without further locality, *Milne* 183. "KANDAVU or Navua River, VITI LEVU": *Seemann* 575, p. p. OVALAU: Main range west of Levuka, *Gillespie* 4433. NGAU: Hills east of Herald Bay, inland from Sawaieke, *Smith* 7783. VANUA LEVU: MBUA: Inland from Nandi, *MacGillivray* 209. MATHUATA: Seanggangga Plateau, vicinity of Natua, *Smith* 6721; vicinity of Lambasa, *Greenwood* 45A. THAKAUNDROVE: Ngarakavukavu, *DA* 16041. TAVEUNI: Inland from Somosomo, *Gillespie* 4840. VANUA MBALAVU: Northern end of island, *Bryan* 575.

2b. *Podocarpus neriifolius* var. *degeneri* N.E. Gray in J. Arnold Arb. 39: 467. 1958;
J.W. Parham, Pl. Fiji Isl. ed. 2. 75. 1972. FIGURE 38A & B.

Podocarpus (polystachya ?) sensu Seem. in Bonplandia 9: 259, p. p. 1861, Viti, 442, p. p. 1862; non R. Br.

Podocarpus bracteata sensu Seem. Fl. Vit. 266, p. p. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 352, p. p. 1892; non Bl.

Podocarpus neriifolia sensu Gibbs in J. Linn. Soc. Bot. 39: 183. 1909; non sensu typi.

This endemic Fijian variety is very similar to the typical variety; it occurs at elevations between 40 and 900 m. in often dense forest or in thickets along creeks, as a tree 3–18 m. high, with a trunk diameter of 50 cm. or more. Its branches are often noted as drooping into the water of streams. Pollen cones and young seed cones have been obtained between July and December, while fruits are found throughout the year; they are similar to those of the typical variety.

TIPIFICATION: The type is *Degener* 14272 (A HOLOTYPE; ISOTYPES at BISH, K, MO, NY, US, etc.), collected in fruit between Feb. 4 and March 26, 1941, in the vicinity of Nandarivatu, Mba Province, Viti Levu.

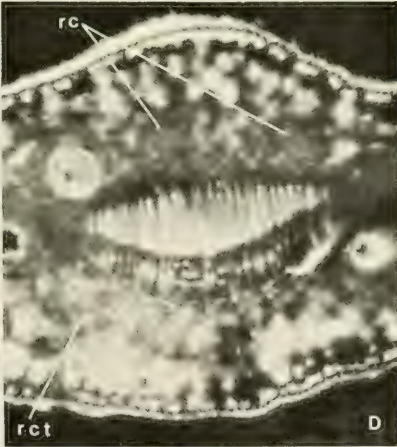
DISTRIBUTION: Endemic to Fiji and thus far known from Viti Levu, Kandavu, and Vanua Levu. I have referred more than 50 collections to this variety.

LOCAL NAMES AND USES: As in var. *neriifolius*, the usual Fijian names are *kuasi* and *asimbolo*; also recorded are *yasimbolo*, *ngangali*, *kasi*, and *mbaukiwangga*. The wood is used for the same purposes as that of var. *neriifolius*, and it is unlikely that Fijians or other foresters distinguish between the varieties.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Mountains near Lautoka, *Greenwood* 45, 50A; top of Ndelai-O, Tavua, *de Laubenfels* P322; vicinity of Nandarivatu, *Gibbs* 743; hills between Nggaliwana and Nandala Creeks, south of Nauwanga, *Smith* 5665; Navai, track to Mt. Tomanivi, *DA* 14969. NANDRONGA & NAVOSA: Nausori Highlands, *DF* 833 (*SI*1414/5), *DA* 13504. SERUA: Nambukelevu, *DA* L.13653 (*Berry* 98); banks of Navua River, *Gillespie* 3382. NAMOSI: Mt. Voma, *de Laubenfels* & Kuru-voli, Nov. 7, 1964; Waikava, *DA* 2154. NAITASIRI: Waimanu River, *DA* 15580. "KANDAVU or Navua River, VITI LEVU": *Seemann* 575, p. p. KANDAVU: Naikorokoro, *DF* 676 (*SI*1414/1). VANUA LEVU: MBUA: Vicinity of Nandi, *Milne* 216. THAKAUNDROVE: Navonu Creek, Natewa Peninsula, *Howard* 221. VANUA LEVU without further locality, *Milne* 254.

The only character utilized by Gray to distinguish her var. *degeneri* from var. *neriifolius* was the fact that the mature leaves of the former are consistently the narrower. Seemann was also aware of a subtle difference between the two collections

FIGURE 38. A & B, *Podocarpus neriifolius* var. *degeneri*, from *DA* 14969; A, terminal branchlet with seed cones, $\times 1$; B, mature seed cones, $\times 4$. C, *Podocarpus neriifolius* var. *neriifolius*, freehand, unstained, transverse section of region of vascular bundle of leaf, lacking resin canals above the vascular bundle, $\times 70$, from *Smith* 6721. D, *Podocarpus decipiens*, freehand, unstained, transverse section of region of vascular bundle of leaf, showing two resin canals (rc) above the vascular bundle and a resin canal in the transfusion tissue (ret) below the vascular bundle, $\times 70$, from *Smith* 6000.



he combined under his no. 575, but he considered the difference to lie in the flat vs. recurved leaf margins. In fact, the two aspects of *Podocarpus neriifolius* in Fiji, although usually separable, are scarcely worthy of the category of varieties; perhaps even to name them as forms would be charitable. I suspect that the form most frequently found semisubmerged in streams has the narrower leaves (var. *degeneri*) and is no more than an ecological variant, but for the time being I prefer to adopt Gray's treatment.

3. *Podocarpus decipiens* N. E. Gray in J. Arnold Arb. 36: 204. pl. I, fig. 3, 4. 1955; J. W. Parham, Pl. Fiji Isl. 43. 1964, ed. 2. 74. 1972. FIGURE 38D.

The third species of *Podocarpus* known from Fiji is a tree 5–20 m. high (rarely noted as a shrub 1–4 m. high), with a straight, slender trunk. It is found at elevations of sea level to 1,053 m., often being locally abundant in dense or light forest, sometimes along streams, and sometimes at the edges of tidal swamps. Pollen cones and fruits have been collected essentially throughout the year; the fruits are gray when young but bluish and glaucous when mature, with a red pedicel.

TIPIFICATION: The type is *Smith 5075* (HOLOTYPE ILL; ISOTYPES at A, BISH, K, etc.), collected July 3, 1947, on the slopes and summit of Mt. Ndelaioö, on the escarpment west of Nandarivatu, Mba Province, Viti Levu.

DISTRIBUTION: Endemic to Fiji, and thus far known from Viti Levu, Vanua Levu, and Taveuni. I have referred about 40 collections to this species.

LOCAL NAMES AND USES: This species is not distinguished from *Podocarpus neriifolius* by Fijians and other foresters, who apply to it the same local names, most commonly *kuasi* and *asimbolo*, but also *yasimbolo*, *ngangali*, *ngali*, *salusalu*, and *mbau*. (The last two names are suspect, being recorded only once for this plant and generally used for others.) Like *P. neriifolius*, it is valued as a timber tree and the wood is used for similar purposes.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Mt. Koroyanitu, Mt. Evans Range, *Smith 4116*, *de Laubenfels P333*; slopes of Mt. Nairoa, *Smith 4092*; Koro-O, west of Nandarivatu, *Berry 832*; vicinity of Nandarivatu, *Gillespie 4227*; Navai, *de Laubenfels P320*; hills between Ngaliwana and Tumbindreketi Creeks, east of Navai, *Smith 6000*. NANDRONGA & NAVOSA: Nausori Highlands, *DA 12662* (*Melville et al. 7037*), *de Laubenfels P301*. SERUA: Namboutini, *DF 1128* (*SI141/9*); Korovisilou, *DF 736* (*SI141/4*); hills west of Waivunu Creek, between Ngaloa and Korovou, *Smith 9286*. NAMOSI: Vicinity of Namosi, *Parks 20197*. NAITASIRI: Waindina River, *DA 171*; Waimanu River, *DA L 13242* (*Berry 51*); Tholo-i-suva, *DA 9275* (*McKee 2842*). TAILEVU: Hills east of Wainimbuka River, vicinity of Ndakuivuna, *Smith 7218*. REWA: Mt. Korombamba, *Parks 20146*. VANUA LEVU: MBUA: Between Wailevu and Mbua, *DA 1112*. MATHUATA: Ndreketi District, near Mbasakalave, *Stauffer & Kuruvoli 5849*; Savusavu-i-tangga ridge, *DA 3757* (*Harwood 84*). THAKAUNDROVE: Mt. Kasi, Yanawai River region, *Smith 1769*. TAVEUNI: Slopes of Mt. Manuka, east of Wairiki, *Smith 8340*.

In separating her subsections *F* and *B* of sect. *Podocarpus*, Gray emphasizes the importance of anatomical characters, subsection *F* (with two species in New Caledonia, one in Fiji, and one in Tonga) having two or more resin canals above the vascular bundle of the leaf, these being absent in subsection *B*. Although the presence or absence of such resin canals above the vascular bundle can be detected in freehand transections (cf. FIGURE 38C & D), this character is not very practicable without the use of laboratory equipment. More useful in field and herbarium differentiation are the prevailingly larger leaves of *P. decipiens* and the broader midrib, which is flattened or only slightly prominent; in contrast, *P. neriifolius* as a rule has narrower leaves and the midrib is often abruptly prominent, especially on the upper surface. However, Gray hypothesizes that hybridization between the two species sometimes occurs and admits the difficulties of positive identifications.

FAMILY 3. ARAUCARIACEAE

ARAUCARIACEAE Henkel & Hochst. Syn. Nadelhölzer 17: 1, as *Araucarieae*. 1865.

Diocious or rarely monoecious trees, the leaves opposite or spirally arranged, broad or acicular and compressed, sometimes pungent; pollen cones large, catkin-like, axillary or terminal on short shoots, the microsporophylls numerous, spirally arranged, the sporangiophore expanded to form a tough scale bearing 5–15 microsporangia, these large, free, borne on lower surface of scale; seed cones large, terminal on short shoots, eventually disintegrating, the cone scales numerous, spirally imbricate, fused to a large extent to the subtending bract, usually broad, sometimes narrow-conical, sometimes winged, terminally thickened, bearing 1 or less commonly 2 ovules (megasporangia), the ovule(s) overgrown by a flap of cone scale tissue, the micropyle exposed only at a basal notch; cotyledons mostly 2, rarely 4.

DISTRIBUTION: This essentially Southern Hemisphere family of two genera and about 38 species occurs from southeastern Asia and the Philippines through Malesia to Australia and New Zealand and westward to New Caledonia and Fiji (*Agathis* only); in the New World the genus *Araucaria* is also found in southern South America. The family is absent from Africa.

USEFUL TREATMENT OF FAMILY: Laubenfels, D.J. de. Araucariaceae. Aubréville & Leroy, Fl. Nouv. Caléd. et Dépend. 4: 80–143. 1972.

KEY TO GENERA

- Leaves scalelike and thick, or flattened and sharp-pointed, in our species not more than 5×1.2 cm.; seeds united with the cone scales; cultivated only in Fiji. 1. *Araucaria*
 Leaves broad and flattened, rounded or obtuse at apex, in our species only infrequently smaller than 5×1.5 cm. and usually much larger; seeds borne on the upper side of cone scales and not united with them; one indigenous and one cultivated species in Fiji. 2. *Agathis*

1. *ARAUCARIA* Juss. Gen. Pl. 413. 1789; Pilger in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. 13: 263. 1926.

Symmetrical trees, the leaves scattered, more or less whorled, usually acicular, often laterally compressed when young and dorsally flattened on fruiting branches; microsporophylls very numerous; seed cones large, broadly ellipsoid or globose, the scales thickened in center, with narrow or winged margins, the seeds entirely adnate to bract, not winged.

TYPE SPECIES: *Araucaria imbricata* Pavon, nom. illeg. = *A. araucana* (Mol.) K. Koch (*Pinus araucana* Mol.).

DISTRIBUTION: About 18 species distributed in the Old World from New Guinea and eastern Australia to Norfolk Island, New Caledonia, and New Zealand, and in the New World in southern Brazil and Chile. Many species are highly ornamental and are widely cultivated; all have useful timber and are used in many countries in reforestation. Three species are known to be cultivated in Fiji.

KEY TO SPECIES

- Leaves lanceolate, flat, commonly $13\text{--}50 \times 7\text{--}12$ mm. 1. *A. bidwillii*
 Leaves needlelike or narrowly triangular, mostly not exceeding 15×4 mm.
 Tree symmetrically cone-shaped, the branches horizontal or drooping; leaves normally $6\text{--}10 \times 1\text{--}1.5$ mm. 2. *A. heterophylla*
 Tree less symmetrical, the upper branches ascending, the lower ones horizontal; leaves normally $6\text{--}15 \times 2\text{--}4$ mm. 3. *A. cunninghamii*

1. *Araucaria bidwillii* Hook. in London J. Bot. 2: 503. t. 18, 19, as *A. bidwillii*. 1843; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 10: 113. 1939; J. W. Parham in op. cit. 19: 95. 1948, in op. cit. 29: 31. 1959, Pl. Fiji Isl. 41. 1964, ed. 2. 71. 1972.

Araucaria bidwilli W.D. Francis, Austral. Rain-For. Trees, 45. fig. 18, 19. 1929.

Large tree, where native attaining a height of 45 m. and a trunk diameter of 1.5 m.

TYPIFICATION: The holotype (κ) was collected by J.T. Bidwill in the Mt. Brisbane range of hills, 70 miles northwest of Moreton Bay, Queensland, Australia.

DISTRIBUTION: Endemic to eastern Queensland; cultivated elsewhere. Although only one Fijian specimen is at hand, the species has been established by the Fiji Department of Forestry. It was first introduced in 1923 (B.E.V. Parham, 1939, cited above).

LOCAL NAME AND USE: *Bunya-bunya pine*; in Queensland it is commonly known simply as *bunya-bunya*. It is an important timber tree and was introduced into Fiji for that potential.

AVAILABLE COLLECTION: VITI LEVU: NAITASIRE: Kalambo, Department of Forestry planting near Tholo-i-suva, DA 16420.

W.D. Francis (1929, cited above, and also in ed. 2, 1951, and ed. 3, 1970), gives good descriptions and illustrations of this species and *Araucaria cunninghamii*.

2. *Araucaria heterophylla* (Salisb.) Franco in Anais Inst. Super. Agron. 19: 11. 1952; J.W. Parham, Pl. Fiji Isl. ed. 2. 71. 1972.

Cupressus columnaris Forst. f. Fl. Ins. Austr. Prodr. 67, p. p., quoad loc. nat. "Norfolciae insula." 1786. *Dombeya excelsa* Lamb. Descr. Gen. Pinus, App. 87, p. p. t. 39, fig. b, c, d, g, h, i, k, t. 40, excl. syn. Forst. f. 1806.

Eutassa heterophylla Salisb. in Trans. Linn. Soc. 8: 316. 1807.

Araucaria excelsa sensu B.E.V. Parham in Agr. J. Dept. Agr. Fiji 10: 113. 1939; Yuncker in Bishop Mus. Bull. 178: 19. 1943; J.W. Parham in Agr. J. Dept. Agr. Fiji 19: 96. fig. 9. 1948; Yuncker in Bishop Mus. Bull. 220: 48. 1959; J.W. Parham, Pl. Fiji Isl. 41. 1964; non R. Br.

Large tree where native and also in cultivation, although in Fiji only comparatively young plants have been noted.

TYPIFICATION AND NOMENCLATURE: The type of *Eutassa heterophylla*, the basionym, is a Norfolk Island specimen collected by P.G. King. In proposing this binomial in 1807, Salisbury indicated that *Cupressus columnaris* Forst. f. (and by implication *Dombeya excelsa* Lamb.) should be typified by a New Caledonian plant and hence does not enter into the synonymy of *Araucaria heterophylla*. The correct binomial for the New Caledonian element is *Araucaria columnaris* (Forst. f.) Hook. For clarification of this complex situation, the reader is referred to Franco's 1952 solution, which is now generally accepted.

DISTRIBUTION: Endemic to Norfolk Island; now widely cultivated elsewhere. It was first introduced into Fiji in 1933 (B.E.V. Parham, 1939, cited above) and has been established by the Fiji Department of Forestry as a potential timber tree.

LOCAL NAME AND USES: *Norfolk Island pine*; it is highly ornamental as well as a timber tree.

AVAILABLE COLLECTION: VITI LEVU: NAITASIRE: Kalambo, Department of Forestry planting near Tholo-i-suva, DA 16414.

3. *Araucaria cunninghamii* Ait. ex D. Don in Lamb. Descr. Gen. Pinus, ed. 2. 3: 59. t. 79. 1837; W.D. Francis, Austral. Rain-For. Trees, 45. fig. 16, 17. 1929; Renkema & Ardagh in J. Linn. Soc. Bot. 48: 456. 1930; B.E.V. Parham in Agr. J. Dept. Agr. Fiji 10: 113. 1939; J.W. Parham in op. cit. 19: 95. 1948, Pl. Fiji Isl. 41. 1964, ed. 2. 71. 1972.

Araucaria cunninghamii Sweet, Hort. Brit. ed. 2, 475, nom. nud. 1830.

Large tree, where native up to 60 m. high and with a trunk diameter up to 1.8 m.; in Fiji only young plants have been noted.

TYPEFICTION: The holotype is *Cunningham* (κ), from Australia. Sweet in 1830 lists the specimen as "Cunningham's N. Holl. 1827."

DISTRIBUTION: According to Francis, the species occurs naturally in coastal scrubs of Australia (Hastings River, New South Wales, to northern Queensland) and also in the mountains of New Guinea. It is widely cultivated elsewhere.

LOCAL NAME AND USE: No name has been noted in Fiji, but in Australia this species is called *hoop pine*. It was introduced into Fiji in 1920 (B.E.V. Parham, 1939, cited above) and has been established by the Fiji Department of Forestry as a potential timber tree.

AVAILABLE COLLECTION: VITI LEVU: NAITASIRI: Kalambo, Department of Forestry planting near Tholo-i-suva, DA 16419.

2. *AGATHIS* Salisb. in Trans. Linn. Soc. 8: 311. 1807; Pilger in Engl. & Prantl, Nat. Pflanzenfam. ed. 2, 13: 266. 1926; A.C. Sm. in J. Arnold Arb. 36: 274. 1955. Nom. cons.

Dammara Rumph. Herb. Amb. 2: 174. 1741; Seem. Fl. Vit. 263. 1868.

Trees with straight, often massive trunks, the leaves scattered but on side branches often subopposite, sometimes subterete but in our species flattened and lanceolate; microsporophylls very numerous; seed cones with scales lacking a ligule, thickened in center, thinner at margins but not winged, the ovules attached only at base; mature seed cones large, globose-ellipsoid, the scales becoming coriaceous or woody, the terminal thickening transversely broadened, the seeds entirely free, winged on one side or rarely on both sides.

TYPE SPECIES: *Agathis loranthifolia* Salisb., nom. illeg. = *A. dammara* (Lamb.) L.C. Rich. (*Pinus dammara* Lamb.).

DISTRIBUTION: About 20 species distributed from southeastern Asia through Malesia to Australia, New Zealand, New Caledonia, the New Hebrides, and Fiji, where it is represented by a single endemic species. A second species is sparsely cultivated in Fiji.

KEY TO SPECIES

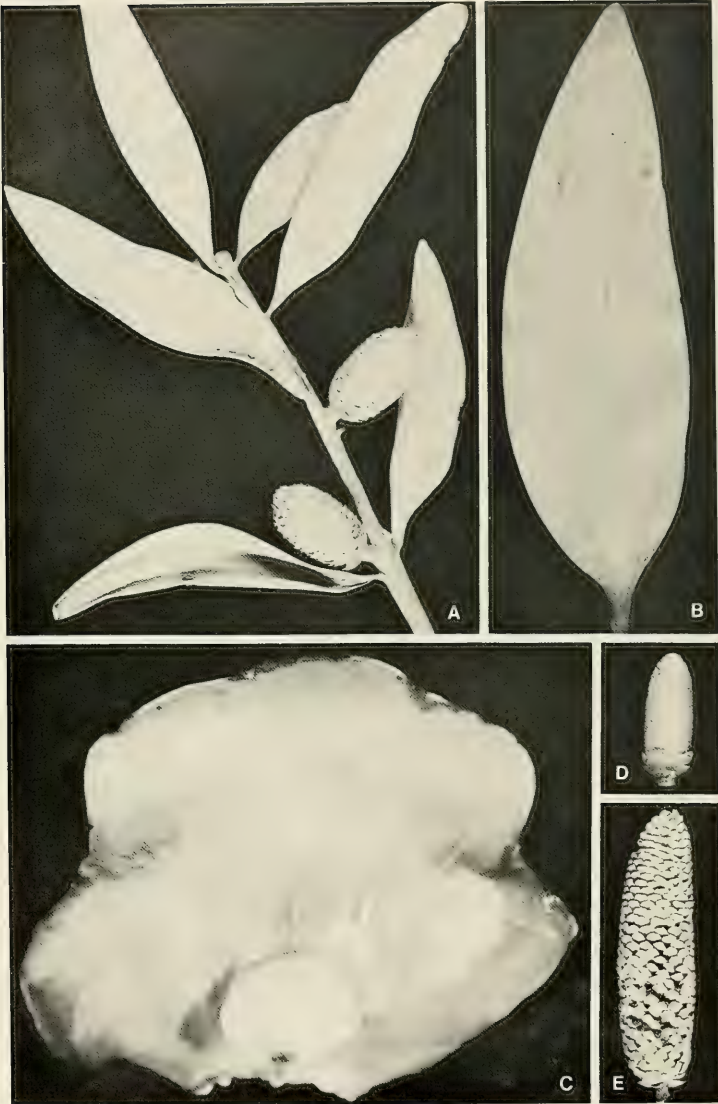
- Tree in cultivation only in Fiji, the branches spreading more or less horizontally, the foliage very dense; mature leaves narrowly elliptic, 5–10 cm. long, 3–5 times as long as broad, narrowly rounded at apex, the juvenile leaves up to 13 × 4 cm.; pollen cones 5–10 cm. long, up to 1 cm. in diameter; seed cones ovoid, up to 13 cm. long at maturity. 1. *A. robusta*
- Tree indigenous in Fiji, the branches forming a crown terminating a long, massive trunk, the foliage comparatively sparse; mature leaves lanceolate, 3.5–8 cm. long, 0.8–3 cm. broad, subacute to obtuse at apex, the juvenile leaves up to 13 × 5 cm.; pollen cones about 5 cm. long and 1.5 cm. in diameter; seed cones globose, up to 10 cm. in diameter at maturity. 2. *A. vitiensis*

1. *Agathis robusta* (C. Moore ex F. v. Muell.) F.M. Bailey, Cat. Woods Queensland, 83. 1886; W.D. Francis, Austral. Rain-For. Trees, 42, fig. 14, 15. 1929; J.W. Parham, Pl. Fiji Isl. ed. 2, 69. 1972.

Dammara robusta C. Moore ex F. v. Muell. in Trans. Pharm. Soc. Victoria 2: 174. 1860.

Large tree, where native up to 46 m. high and with a trunk diameter up to 2.5 m.; in Fiji only young plants have been noted.

TYPEFICTION: The type comes from Wide Bay, Queensland, Australia. There is a presumptive isotype at κ, of which the collector was either Mueller or G.M. Leay.



DISTRIBUTION: According to Francis (cited above, and also in his eds. 2 and 3), whose description and illustrations are excellent, the species occurs in a limited area of southern Queensland and on Fraser Island. It is cultivated elsewhere.

LOCAL NAMES AND USES: No local names have been noted in Fiji, but in Queensland the species is called *kauri pine*, *dundathu pine*, *South Queensland kauri pine*, and *Queensland kauri*. It is an important timber tree in Australia and is also highly ornamental.

AVAILABLE COLLECTIONS: VITI LEVU: NAITASIRI: Kalambo, Department of Forestry planting near Tholo-i-suva, DA 16421, 16428.

2. *Agathis vitiensis* (Seem.) Benth. & Hook. f. ex Drake, Ill. Fl. Ins. Mar. Pac. 353. 1892; Gibbs in J. Linn. Soc. Bot. 39: 183. 1909; J. W. Parham in Agr. J. Dept. Agr. Fiji 19: 95. fig. 8. 1948; A. C. Sm. in J. Arnold Arb. 36: 274. 1955; G. Watkins in Agr. J. Dept. Agr. Fiji 31: 12. fig. 1961; J. W. Parham, Pl. Fiji Isl. 41. fig. 20. 1964, ed. 2. 69. fig. 20. 1972. FIGURES 24, 39.

Dammara vitiensis Seem. in Bonplandia 9: 259, nom. nud. 1861, Viti, 442, nom. nud. 1862; Seem. ex G. Gordon, Pinetum, Suppl. 28, nom. nud. 1862; Seem. Fl. Vit. 265. t. 76. 1868; G. Gordon, Pinetum, ed. 2. 113. 1875.

Dammara longifolia Lindl. ex G. Gordon, Pinetum, Suppl. 28, nom. provis. 1862.

Agathis longifolia Warb. Monsunia, 186, nom. illeg. 1900.

The indigenous Fijian *Agathis* is a stately tree (10–) 25–33 m. high, with a trunk diameter of 1.5–3 m. at maturity, the trunk exuding copious resin and often free of branches to a height of 20 m. It occurs from near sea level to 1,150 m. in dense, dry, or secondary forest. Its ellipsoid or globose fruit attains a diameter of 10 cm.; pollen cones, seed cones, and mature fruits seem to occur throughout the year. Probably the fruits require two years to develop to full maturity.

LECTOTYPIFICATION AND NOMENCLATURE: The first mention of this taxon, as *Dammara vitiensis*, appears to have been by Seemann in his preliminary 1861 list in *Bonplandia*, the full entry being: "577. *Dammara Vitiensis*, Seem. vulgo "Dakua.";" this is clearly a nomen nudum. Seemann's and Gordon's 1862 mentions are also nomina nuda, and therefore the first valid use of the binomial was in *Flora Vitiensis*. From Seemann's comments there, one might assume that *Dammara vitiensis* had been mentioned in G. Bennett's *Gatherings of a Naturalist in Australasia* (1860), but in Bennett's extended discussion of *Dammara* (pp. 348–353) there is no mention of that binomial; Seemann therefore must have been alluding only to the generic discussion. Before 1868 Gordon in 1862 had used the binomial *Dammara longifolia*, the full entry being: "*Dammara longifolia*, Lindley, a kind with long, broad leaves, found in the Feejee Islands, and probably not different from *D. macrophylla*." I believe that this binomial may be taken as a provisional name, not accepted by the author, even though it clearly refers to the Fijian species and antedates any valid publication of the epithet *vitiensis*. In his second edition (1875), Gordon reduces *D. longifolia* to *D. vitiensis*. The first unequivocal and valid publication of the Fijian taxon, therefore, is that of Seemann in 1868. *Agathis longifolia* (Lindl. ex Gordon) Warb., being based on a provisional name, is illegitimate.

FIGURE 39. *Agathis vitiensis*: A, branchlet with young pollen cones, $\times 1$, from DA 13321; B, juvenile leaf, lower surface, $\times 1$, from Smith 5497; C, scale and developing seed of half-grown seed cone, $\times 6$, from DA 14884; D, young pollen cone, $\times 1$, from Parks 20859; E, mature pollen cone, $\times 1$, from Gillespie 2027.

The type of *Dammara vitiensis* is *Seemann 577*, indicated in *Flora Vitiensis* as from Vanua Levu, Viti Levu, Ovalau, and Kandavu, on all of which islands Seemann doubtless observed it. At both K and BM there are two specimens of *Seemann 577* (at BM mounted on a single sheet). The K sheets are indicated as: (1) "specimen from an old tree; cones in the Museum. Korovono" and (2) "specimen from a young tree." The first K specimen is the better of the two and the only one with a locality; it seems to have been the model for the Seemann plate (except for his *fig. 1*, which depicts a leaf from a young tree). Therefore I herewith designate the first K specimen as the lectotype; the locality is Koroivonu (as correctly spelled), on the eastern shore of the Natewa Peninsula a few miles north of Mbutha Bay, Thakaundrove Province, Vanua Levu. Seemann visited Koroivonu only once, on June 4, 1860. The other extant collections labelled *Seemann 577* are not strictly isoelectotypes.

DISTRIBUTION: Endemic to Fiji, and thus far known only from the islands of Viti Levu, Kandavu, Ovalau, and Vanua Levu. I have examined approximately 70 collections in addition to the several combined into *Seemann 577*. The species is now cultivated in Hawaii and doubtless elsewhere.

LOCAL NAMES AND USES: *Ndakua* is the well known Fijian name; *ndakua makandre* is also used, but *makandre* is actually the Fijian word for the exuded resin. *Fiji kauri* is an obviously artificial local name. *Ndakua* is the most important timber tree of Fiji, currently accounting for 28% of Fiji's timber production (*Some Timbers of Fiji*, 1968, published by the Fiji Department of Forestry and authored by A. S. Alston). As early as 1868 Seemann was bemoaning the havoc wrought to *ndakua* by European sawyers, but in fact the species is still abundant and actively reproducing in many areas of the two large islands. The wood is highly valued for furniture, boat-building, veneer, etc. The resin (*makandre*) that exudes from the trunk is also found in huge lumps under old stumps; Fijians use it for glazing pots and also for torches. The interested reader is referred to Seemann's excellent account of the species (and the genus as then known) of 1868.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Vicinity of Nandarivatu, *Mead 1985*, *Gillespie 4283*; Mt. Nanggaranambuluta, *Vaughan 3249*; Sovutawambu, *Degener 14671*. NANDRONGA & NAVOSA: Nausori Highlands, *DA 13321*, *14884*; northern portion of Rairaimatuku Plateau, *Smith 5497*. SERUA: Inland from Namboutini, *DF 579* or *803 (S1412/7)*; inland from Ngaloa, *DF 580* or *804 (S1412/6)*; hills east of Navua River, near Nukusere, *Smith 9090*. NAMOSI: Mt. Naitarandamu, *Gillespie 3244*; southeast of Namosi, *Gillespie 2841*. NAITASIRE: Waindina River, *MacDaniels 1051*; Waimanu River, *DA L.13238 (Berry 40)*; Tholo-i-suva, *DA 14607*; vicinity of Tamavua, *Gillespie 2027*. TAILEVU: Without further locality, *Valentine* in 1937. REWA: Mt. Korombamba, *Gillespie 2224*; Suva Botanical Gardens, cult., *MacDaniels 1130*. VITI LEVU without further locality, *Parks 20859*. KANDAVU: Naikorokoro, *DF 713 (S1412/2)*; Kiombo, *DA 11922*. OVALAU: *Milne 257*. VANUA LEVU: MBUA: Mt. Seatura, *Smith 1640*. MATHUATA: Sasa Tikina, *Berry 105*; Nakoroutari, *DA 15229*. THAKAUNDROVE: Hills west of Mbutha Bay, Natewa Peninsula, *Smith 836*.

FAMILY 4. PINACEAE

PINACEAE Lindl. Nat. Syst. Bot. ed. 2. 313. 1836.

Monoecious trees or rarely shrubs, resinous; leaves spirally arranged, acicular, linear, produced on normal branches or determinate short shoots, then seemingly whorled or fascicled; micro- and megasporangiate fructifications strobiloid; microsporangiate cones bearing a spiral sequence of sporangiophores, each with a sterile distal flap and a pair of elongate microsporangia; megasporangiate cones composed of many spirally arranged imbricate bracts with undivided ovuliferous scales in their axils, each of these bearing 2 inverted ovules (megasporangia) on its adaxial (upper)

surface; bracts (cone scales) when mature diverging or falling off, more or less woody, mostly consisting of the much enlarged ovuliferous scale and shieldlike apex (apophysis); seeds 2 in each ovuliferous scale, subobliquely winged on one side, the wings mostly large, the cotyledons 4–15.

DISTRIBUTION: This basically Northern Hemisphere family of ten genera and about 250 species extends southward to northern Africa and Sumatra in the Old World and to Central America and the West Indies in the New World. Only its largest genus, *Pinus*, is found in Fiji, where two species are cultivated.

1. *PINUS* L. Sp. Pl. 1000. 1753; Pilger in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. **13**: 331. 1926.

Important timber trees, producing determinate short shoots in the axils of scale leaves, each short shoot with a short axis, an aborted apex, and 10–15 leaves; 1–5 distal leaves developing into vegetative leaves, the remaining leaves enveloping the short shoot axis as dried, resinous scales; microstrobili resembling catkins, spicately crowded around base of young normal branches; megastrobili subterminal near apices of young normal branches, solitary or few together; ovuliferous scales at anthesis longer than bracts; seeds with a lateral, often easily separating wing.

LECTOTYPE SPECIES: *Pinus sylvestris* L., one of the ten species originally included by Linnaeus (vide Pilger, 1926, cited above, p. 332).

DISTRIBUTION: 94–100 species with essentially the distribution of the family. Many species are widely cultivated as ornamentals and for their valuable timber.

USEFUL TREATMENT OF GENUS: Critchfield, W. B., & E. L. Little, Jr. Geographic distribution of the pines of the world, U.S. Dept. Agr. For. Serv. Misc. Publ. **991**: 1–97, maps 1–61. 1966.

According to the classification adopted by Critchfield & Little, the two species cultivated in Fiji fall into subgen. *Pinus*, sect. *Pinus*, subsect. *Australes*.

KEY TO SPECIES

- | | |
|---|-----------------------|
| Leaves mainly in threes; seeds to 6 mm. long, retaining wings. | 1. <i>P. caribaea</i> |
| Leaves in threes or 2–5; seeds larger, losing wings. | 2. <i>P. elliotii</i> |

1. *Pinus caribaea* Morelet in Rev. Hort. Côte d'Or **1**: 107. 1851, in Bull. Soc. Hist. Nat. Moselle **7**: 97. 1885; G. R. Shaw in Gard. Chron. III. **36**: 98. 1904; J. W. Parham, Pl. Fiji Isl. 41. 1964, ed. 2. 71. 1972; Critchfield & Little in U.S. Dept. Agr. For. Serv. Misc. Publ. **991**: 16, map 46. 1966.

This introduced species becomes a large tree; in Fiji it is extensively cultivated in lowland and upland dry areas and also in grassland, at elevations from near sea level to 800 m.

TIPIFICATION: The type is from the Isle of Pines, Cuba.

DISTRIBUTION: Indigenous in the West Indies and Central America, *Pinus caribaea* occurs naturally in the Bahamas, in Pinar del Río and the Isle of Pines in Cuba, and along the Caribbean seaboard of Central America from Belize to Nicaragua.

LOCAL NAME AND USES: *Caribbean pine*, the widely used name for this species, has also been adopted in Fiji. It is a softwood timber tree of potential use for general construction, pulp, etc. Both this species and the next, *Pinus elliotii*, are relatively recent introductions into Fiji, but during the past 15 or 20 years the Fiji Department of Forestry has conducted tests and has established a large scale project of afforestation, particularly in northern and northwestern Viti Levu. On the slopes of the escarpment north of Nandariatu and in the area southward, even including the for-

est at the base of Mt. Tomanivi, where local timber trees have been cut on a large scale, these two pines have been planted in tremendous numbers. Of the two, *P. caribaea* is considered the more promising (*Some Timbers of Fiji*, 1968, published by the Fiji Department of Forestry, pp. 56-59). While the beautiful Fijian forests composed in part of *Agathis*, *Decussocarpus*, *Dacrycarpus*, and *Dacrydium* are still very extensive, the inroads upon their margins are significant, and the planting of pure stands of pine would seem to be a pitiful substitute.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Tavakumbu Forest Reserve near Lautoka, *DA T.2, DF 744 (T.1), 746 (T.3), T.4*; Koro-O road, west of Nandarivatu, *DA 13534*. NAITASIRI: Tholo-i-suva, *DA 16950*; Kalambo, *DA 16423*. VANUA MBALAVU: Near Lomaloma, *Garnock-Jones 1094*. LAKEMBA: Between Levuka and Wathiwathi, *Garnock-Jones 971*.

2. *Pinus eliottii* Engelm. in Trans. Acad. Sci. St. Louis **4**: 186. *pl. 1-3*. 1880; J. W. Parham, Pl. Fiji Isl. 41. 1964, ed. 2. 71. 1972; Critchfield & Little in U.S. Dept. Agr. For. Serv. Misc. Publ. **991**: 16. *map 45*. 1966.

Pinus taeda var. *heterophylla* Elliott, Sketch Bot. S. Car. and Georgia **2**: 636. 1824.

This introduced species is now cultivated in afforestation projects in Fiji. Although once interpreted as included in *Pinus caribaea*, this species is now considered distinct and readily separable.

TYPIFICATION: Since *Pinus taeda* var. *heterophylla* was included in the synonymy by Engelm and an Elliott specimen was among the several cited, the type of the variety, collected by Elliott near the mouths of freshwater rivers in Georgia, may be considered also the type of the species. If it still exists, the Elliott holotype is probably deposited at CHARL (The Charleston Museum, Charleston, South Carolina).

DISTRIBUTION: Indigenous in the southeastern United States, from southern Mississippi to southern South Carolina southward into Florida. Critchfield and Little (1966, cited above) discuss two varieties, var. *elliottii* and var. *densa*, which replaces the typical variety in the southern half of Florida. No Fijian collections have been seen, but the presence of the species is documented in *Some Timbers of Fiji*, pp. 56-59 including two illustrations.

LOCAL NAME AND USES: *Slash pine*, the name used in the indigenous area, has been adopted in Fiji. Its local uses are the same as those of *Pinus caribaea*, but it seems less adaptable in reforestation.

FAMILY 5. CUPRESSACEAE

CUPRESSACEAE Bartling, Ord. Nat. Pl. 90, 95, as *Cupressinae*. 1830.

Diocious or monoecious trees or shrubs, much branched, the leaves decussate or 3- or 4-verticillate, mostly scalelike or acicular; microsporangiate strobili small, mostly on short branches and solitary, consisting of 2-24 decussate or verticillate microsporophylls, these with 2-8 microsporangia borne ventrally; megasporangiate strobili small, dry to fleshy at maturity, terminal or pseudolateral, consisting of an axis bearing a small number of decussate or verticillate scales (megasporophylls), each of these bearing 1-20 erect ovules (megasporangia) at base; mature cones mostly with woody or squarrose scales, the seeds exalate or 2- or 3-winged, the cotyledons 2-6.

DISTRIBUTION: The Cupressaceae, a cosmopolitan family, have a larger number of genera than any other conifer family, 18 or 19 usually being recognized, with 130-136 species. Only two genera are recorded from Fiji, each with a single cultivated or naturalized species.

KEY TO GENERA

- Leaves opposite, densely crowded; mature cones with closely appressed scales, the seeds with narrow, winglike margins but the wings not distinctly membranaceous. 1. *Cupressus*
 Leaves in mutually alternating whorls of 3; mature cones grooved lengthwise between the scales, these in whorls, the seeds flat, more or less 2- or 3-winged. 2. *Callitris*

1. *CUPRESSUS* L. Sp. Pl. 1002. 1753; Pilger in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. 13: 391. 1926.

Trees (our species), the twigs much-branched, distally thin with decussate scale-like leaves; microsporangiate strobili terminal, the microsporophylls decussate, each with 2-6 microsporangia; megasporangiate strobili on short side shoots, the scales (megasporophylls) decussate, peltate, each with 6-20 ovules (megasporangia); mature cones with closely appressed, angular apophyses, the seeds without distinct wings.

LECTOTYPE SPECIES: *Cupressus sempervirens* L., one of Linnaeus's three original species (vide Pilger, 1926, cited above, p. 392).

DISTRIBUTION: *Cupressus* includes 16-20 species occurring in the Mediterranean and Sahara regions, Asia, and North America. Many species yield useful timber and are also ornamental. Only one species has been recorded as introduced into Fiji.

1. *Cupressus benthamii* Endl. Syn. Conifer. 59, as *C. benthami*. 1847; J. W. Parham, Pl. Fiji Isl. 41. 1964, ed. 2. 71. 1972.

Cupressus thurifera sensu Schlechtendal in Linnaea 12: 493. 1838; non H. B. K.

Cupressus thurifera Benth. Pl. Hartw. 57. 1840; non H. B. K.

A tree 4-7 m. high (in Fiji, but becoming much larger where native), found at elevations from near sea level to 800 m. Although known primarily in cultivation, it has also become sparingly naturalized. The mature cones are brown to black and have been noted only in August.

TIPIFICATION AND NOMENCLATURE: *Cupressus thurifera* was described as a new species by Bentham, typified by Hartweg 434, obtained in Mexico at high elevation. As the name is a later homonym, Endlicher proposed *C. benthamii* as a new name for it; however, he questioned the Schlechtendal reference.

DISTRIBUTION: Mexico; but frequently cultivated elsewhere.

LOCAL NAMES AND USES: Only the name *cupressus* has been noted in Fiji, but the species is often called *Mexican cypress*. It was introduced into Fiji as an ornamental and also as a potential timber tree.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Koro-O Road, west of Nandarivatu, DA 13535, REWA: Department of Agriculture compound, DA 12171. FIJI without further locality, DA L.13415 (DF 1218)

2. *CALLITRIS* Vent. Decas Gen. Nov. 10. 1808; Pilger in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. 13: 378. 1926.

Trees, the ultimate twigs thin, with whorled, scalelike leaves; microsporangiate strobili terminal between distal leaves, the microsporophylls verticillate, each with 3 or 4 microsporangia; megasporangiate strobili on short side branches, the scales (megasporophylls) few, verticillate, the inner ones with numerous ovules (megasporangia); mature cones globose-ovoid, the scales thick, with numerous seeds around a central column, the seeds flat, 2- or 3-winged.

NEOTYPE SPECIES: *Callitris rhomboidea* R. Br. ex L. C. Rich. (vide R. T. Baker & H. G. Smith, Res. Pines Austral. 14, 220. 1910).

DISTRIBUTION: About 16 species in Australia and New Caledonia; some are cultivated for their useful timber and ornamental value. There is only one Fijian record of an introduced species.

1. *Callitris glauca* R. Br. ex R.T. Baker & H.G. Sm. in J. & Proc. Roy. Soc. New South Wales **42**: 146. 1908; B.E.V. Parham in Agr. J. Dept. Agr. Fiji **10**: 113. 1939.

A tree, introduced into Fiji in 1920, but since there seem to be no herbarium vouchers it has possibly not survived.

TYPEFICATION: Baker and Smith (1908, cited above) imply that the holotype is a Brown specimen at BM, collected in Australia.

DISTRIBUTION: In the western interior of Australia this species is a prevailing timber tree (Baker & Smith, 1908). According to B.E.V. Parham (1939, cited above), plants were doing well on the property of W.L. Wallace, Tovu Island, Ra Province, Viti Levu, in 1939.

LOCAL NAMES AND USE: Parham notes the names *white cypress pine* and *Murray pine*. As the tree is an important timber source, it was presumably brought into Fiji with that in mind.

CLASS GNETICAE

ORDER GNETALES

FAMILY 6. GNETACEAE

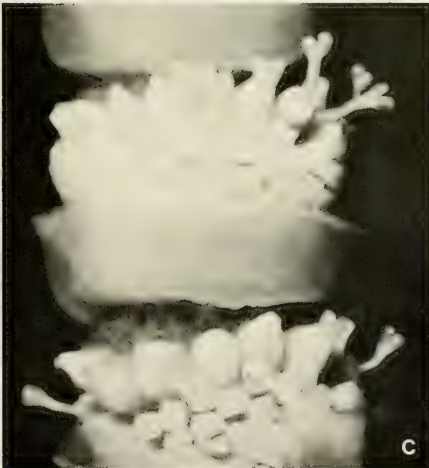
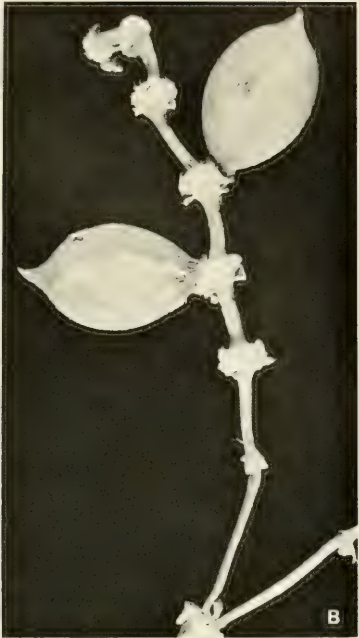
GNETACEAE Lindl. in Bot. Reg. **20**: sub. *t.* 1686. 1834.

Woody, dioecious trees, shrubs, or vines, the nodes often conspicuously swollen, the leaves opposite, with broad blades superficially resembling those of dicotyledons; fructifications lax to compact, compound strobili arising from accessory buds below the axillary buds; microsporangiate strobili spikelike, with short internodes that form a complete cup around each node, each vertical series in the strobilus consisting of a nonfunctional ovule above and a series of functional microsporangiate structures (each actually a simple strobilus with a 2-parted enclosing sheath below and an extending sporangiophore) mixed with numerous moniliform hairs, each microsporangiophore bearing 2 separate sporangia at its tip; megasporangiate strobili bearing ovules arranged in a verticil above each bract, the ovules associated with numerous moniliform hairs, orthotropous, erect, with 2 integuments, constituting the entire simple strobilus; fruit drupelike.

DISTRIBUTION: The Gnetaceae consist of a single genus with 30–35 species in mostly rain forest areas of tropical South America (all American species being vines), west tropical Africa, and Indo-Malesia eastward to Fiji (lacking in Taiwan, Australia, and New Caledonia); cultivated elsewhere. Since the Old World portion of the genus terminates its range in Fiji, it should have been mentioned in my discussion of such distributions (in J. Arnold Arb. **36**: 273–292. 1955).

Gnetum was once considered closely related to *Ephedra* and *Welwitschia*, but gymnosperm students now consider each of the three genera to represent its own order within a single class. The complex relationships of the gnetophytes are well discussed by D.W. Bierhorst, *Morphology of Vascular Plants*, 465–487. 1971.

FIGURE 40. *Gnetum gnemon*: A, tip of branchlet with microsporangiate strobili, × 1, from DA 11960; B, compound megasporangiate strobilus with mature fruits, × 2, from DA 14401; C, portion of compound microsporangiate strobilus showing an internode forming a cup, nonfunctional ovules, microsporangiate structures, and moniliform hairs, × 10, from Smith 9517; D, young megasporangiate strobili, × 1, from Gillespie 3670.



1. *GNETUM* L. Mant. Pl. 18. 1767; Seem. Fl. Vit. 433. 1873; Markgraf in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. 13: 439. 1926, in Fl. Males. I. 4: 337. 1951.

Characters of the family; our species a tree.

TYPE SPECIES: *Gnetum gnemon* L.

DISTRIBUTION: As of the family; one species, *Gnetum gnemon*, occurs indigenously in Fiji.

1. *Gnetum gnemon* L. Mant. Pl. 125. 1767; Drake, Ill. Fl. Ins. Mar. Pac. 352. 1892; Merr. Interpret. Rumph. Herb. Amb. 77. 1917. FIGURE 40.

Gnetum ovalifolium Poir. in Lam. Encycl. Méth. Bot. Suppl. 2 (2): 810. 1812.

Gnetum sylvestris Brongn. in Duperrey, Voy. Coquille Bot.-Phan. 12. 1829.

Gnetum gnemon var. *ovalifolia* Bl. in Ann. Sci. Nat. Bot. II. 2: 105. 1834.

Gnetum gnemon var. *sylvestris* Parlatore in DC. Prodr. 16 (2): 349. 1868; Seem. Fl. Vit. 434. 1873; J. W. Parham, Pl. Fiji Isl. 41. 1964.

Gnetum gnemon var. *gnemon*; Markgraf in Bull. Jard. Bot. Buitenzorg III. 10: 436. 1930, in Fl. Males. I. 4: 340. 1951; J. W. Parham, Pl. Fiji Isl. ed. 2. 69. 1972.

Gnetum gnemon var. *domesticum* Markgraf in Bull. Jard. Bot. Buitenzorg III. 10: 437. *t. 1, fig. 1.* 1930.

Gnetum gnemon var. *silvestre* Parlatore ex Markgraf in Bull. Jard. Bot. Buitenzorg III. 10: 443. *t. 1, fig. 2, 2a.* 1930.

Gnetum gnemon var. *ovalifolium* Bl. ex Markgraf in Fl. Males. I. 4: 341. 1951.

In Fiji *Gnetum gnemon* is an often slender tree 3–15 m. high, with a trunk diameter up to 25 cm., sometimes noted as a shrub 2–4 m. high, and sometimes with subscandent branches. It occurs from near sea level to an elevation of 850 m. in dense or dry forest, ridge forest, coastal forest often on limestone, and in patches of forest in open country. The microsporangiate structures are white and the fruit (really a spurious fruit, the outer fleshy layer being a pair of fused bracts) is red at maturity. Strobili in all conditions of maturity are to be expected throughout the year.

TIPIFICATION AND NOMENCLATURE: Various attempts have been made to divide *Gnetum gnemon*, but examination of much material throughout the range inclines me to agree with Merrill (1917, cited above) that the variation (such as utilized by Markgraf in the branching of the compound microsporangiate strobili and the contiguity or remoteness of the internodal cups) is too haphazard to permit division. Linnaeus based his concept on *Gnemon domestica femina* Rumph. Herb. Amb. 1: 181. *t. 71.* 1741. *Gnetum ovalifolium* is typified by a specimen collected on Amboina by Labillardière, while *G. sylvestris* Brongn. is based on *Gnemon silvestris* Rumph. Herb. Amb. 1: 183. *t. 73.* 1741. Presumably *G. gnemon* var. *domesticum* Markgraf is based on Rumphius's concept as shown in his 1741 *t. 72.*

DISTRIBUTION: The species, taken in its entirety, occurs from Assam throughout Malesia to the Caroline Islands and Fiji. Of the last archipelago I have examined approximately 100 collections, but even these do not give an adequate indication of the abundance of the species. The earliest Fijian collection I have noted was made by Harvey in 1855; this is cited by Seemann and also below.

LOCAL NAMES AND USE: As a plant well known to Fijians, *Gnetum gnemon* has many local names, the most frequent being *sikau*, *sukau*, *mbele sikau*, and *mbele sukau*; other recorded names are *sukau mata*, *sukau mbuli*, *sukau motu*, *mbui ni vondre*, and *masokau*. The young leaves and fruits are edible when cooked in a variety of ways, often with coconut milk as an ingredient.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Hills between Nandala and Nukunuku Creeks, *Smith 6174*; vicinity of Nandarivatu, *Gillespie 4001*. NANDRONGA & NAVOSA: Nausori Highlands, *O. & I. Degener 32171*. SERUA: Mbuyombuyo, near Namboutini, *Tabualeva 15602*; hills between Waininggere and Waisese Creeks, *Smith 9517*. NAMOSI: Hills bordering Wainavindrau Creek, *Smith 8590*; hills near Navua River, *Greenwood 1037*. NAITASIRE: Viria, *DA 482*; Waingganake, Waindina River, *DA 676*;

Tholo-i-suva, *DA 11960*; vicinity of Nasinu, *Gillespie 3670*. TAILEVU: Hills east of Wainimbuka River, vicinity of Ndakuivuna, *Smith 7142*; Naingani Island, *DA 3321*. REWA: Mt. Korombamba, *Vaughan 3325*. KANDAVU: Hills above Namalata and Ngaloa Bays, *Smith 94*; Kiombo, *DA 12438 (DF 83, Watkins 746)*. OVALAU: Mt. Korotolutolu, west of Thawathi, *Smith 8005*; southeast of valley of Mbureta River, *Smith 7449*. KORO: Eastern slope of main ridge, *Smith 942*. VANUA LEVU: MBUA: Seatovo Range, *Smith 1544*; Nandi, *Harver*, Nov. 1855. MATHUATA: Wainunu-Ndreketi divide, *Smith 1842*; mountains near Lambasa, *Greenwood 551*; Wainikoro River, *Greenwood 552A*. THAKAUNDROVE: Eastern drainage of Yanawai River, *Degener & Ordonez 14089*; hills west of Korotasere, Natewa Bay region, *Smith 1938*. FAVEUNI: Wainisavu, Nggeleni, *DA 14401*. VANUA MBALAVU: Northern end of island, *Bryan 576*.

DIVISION ANGIOSPERMAE (MAGNOLIOPHYTA)

KEY TO CLASSES

- Cotyledon 1 (or embryo sometimes undifferentiated); stems without distinctive differentiation into an outer cortex (phloem) and an inner xylem with central pith tissues, the vascular elements usually scattered in the pith; cambium and secondary growth usually lacking; leaves mostly parallel-veined (but with many exceptions); floral parts often in sets of 3, seldom of 4, never of 5, sometimes of indefinite number, the carpels often fewer than 3; pollen of uniaperturate or uniaperturate-derived type. MONOCOTYLEDONES (LILIATAE)
- Cotyledons 2 (seldom 1, 3, or 4); stems usually with an outer cortex (phloem) and an inner cylindrical xylem, the vascular elements most often arranged around the pith; cambium between phloem and xylem usually producing secondary growth; leaves mostly net-veined; floral parts often in sets of 5, sometimes of 4, seldom of 3, sometimes of indefinite number, the carpels often fewer or more numerous than 5; pollen (except in some Magnoliidae) of triaperturate or triaperturate-derived type. DICOTYLEDONES (MAGNOLIATAE)

CLASS MONOCOTYLEDONES (LILIATAE)

KEY TO SUBCLASSES

- Plants always herbaceous, often aquatic or subaquatic; subsidiary cells of the guard cells usually 2; flowers mostly apocarpous (i. e. carpels separate), or if syncarpous then with a modified type of laminar placentation; pollen consistently trinucleate; endosperm often lacking. ALISMATIDAE
- Plants usually terrestrial, less often aquatic; subsidiary cells of the guard cells none to several; flowers mostly syncarpous (i. e. carpels united), or if apocarpous then borne on terrestrial plants; pollen binucleate or trinucleate; endosperm either present or lacking.
- Flowers few to numerous, small to large, usually syncarpous, usually not subtended by a spathe, not aggregated into a spadix, the perianth with 2 somewhat similar and often petaloid series; ovary superior or inferior; seeds mostly with a nonstarchy endosperm or lacking endosperm; plants infrequently arborescent but sometimes with stems showing secondary growth; leaves usually comparatively narrow and parallel-veined (but sometimes broad and net-veined); subsidiary cells of the guard cells usually none, infrequently 2 or more. LILIIDAE
- Flowers with 2 well-differentiated sets of perianth segments, those of the outer series not petaloid, or perianth segments reduced to scales, bristles, or hairs, or sometimes lacking; ovary usually superior, less often inferior; seeds mostly with a starchy endosperm; inflorescence variously composed but the flowers not aggregated into a spadix; plants mostly terrestrial herbs, sometimes epiphytic or climbing, infrequently woody; leaves usually comparatively narrow and parallel-veined; subsidiary cells of the guard cells 2 or more. COMMELINIDAE
- Flowers usually numerous, small, subtended by an often prominent spathe and/or aggregated into a spadix, sometimes in spikes or globose clusters, the perianth segments small or lacking; ovary superior, sometimes sunken in the axis of the spadix; seeds mostly with a nonstarchy endosperm or lacking endosperm; plants often arborescent; leaves often broad, petiolate, and without typically monocotyledonous venation, but sometimes narrow and parallel-veined; subsidiary cells of the guard cells often 4, sometimes 3 or 2, rarely none. ARECIDAE

SUBCLASS ALISMATIDAE

KEY TO ORDERS OCCURRING IN FIJI

- Perianth segments 3 or 6, if 6 with sepals and petals differentiated; flowers often bracteate.
- Carpels free or nearly so; flowers hypogynous; plants of freshwater (rarely brackish) or marshes. ALISMATALES (FAMILIES 7, 8)
- Carpels joined into a compound ovary with parietal placentas; flowers epigynous; plants of freshwater or saltwater. HYDROCHARITALES (FAMILY 9)
- Perianth segments (in our families) lacking or 4, not differentiated into sepals and petals; flowers usually ebracteate; carpels with a single ovule; plants of freshwater or saltwater or marshes. POTAMOGETONALES (FAMILIES 10-12)

ORDER ALISMATALES

KEY TO FAMILIES OCCURRING IN FIJI

- Placentation laminar, the ovules scattered on the carpel walls. 7. LIMNOCHARITACEAE
- Placentation not laminar, the ovules usually solitary at the inner angle of carpel. 8. ALISMATACEAE

FAMILY 7. LIMNOCHARITACEAE

LIMNOCHARITACEAE Takhtajan, *Evol. Angiosp.* 261. 1959.

Alismataceae tribus *Limnocharitaeae* Pichon in *Notul. Syst. (Paris)* 12: 183. 1946.

Usually perennial aquatic herbs, the flowers solitary or umbellate, the stamens 6-numerous, the petals not persistent, the carpels 6-numerous; differing from *Butomaceae* in having leaves differentiated into petiole and lamina, in having latex tubes, in a delicate, nonpersistent inner perianth whorl, in the curved or folded embryo, and in pollen characters; differing from *Hydrocharitaceae* in the superior ovary with ovules scattered on the carpel walls.

DISTRIBUTION: Four genera and probably seven species, in tropical America, subtropical South America, and tropical Africa to Australia. Only one species, of the genus *Hydrocleys*, has been introduced into Fiji.

The family is incorporated into the *Butomaceae* by most authors. If it is considered distinct, the *Butomaceae* are restricted to the genus *Butomus*, with a single species.

1. *HYDROCLEYS* L.C. Rich. in *Mém. Mus. Hist. Nat.* 1: 368. 1815.

Aquatic floating herbs with cauline leaves, the blades broadly ovate; flowers solitary but sometimes crowded; perianth 2-seriate, the 3 outer segments sepal-like and green, the 3 inner segments petal-like, imbricate, deciduous; stamens numerous; carpels few, up to 8, narrow, with short styles.

TYPE SPECIES: *Hydrocleys commersoni* (sic) L.C. Rich., the only species in the original descriptio generico-specifica, = *H. nymphoides* (Humb. & Bonpl. ex Willd.) Buchenau (*Stratiotes nymphoides* Humb. & Bonpl. ex Willd.).

DISTRIBUTION: Four species in tropical South America.

1. *Hydrocleys nymphoides* (Humb. & Bonpl. ex Willd.) Buchenau in *Abh. Naturwiss. Vereine Bremen* 2: 2. 1869; J.W. Parham, *Pl. Fiji Isl.* ed. 2. 348, as *H. nymphaeoides*. 1972; Hutchinson, *Fam. Fl. Pl.* ed. 3. 664. *fig. 343*. 1973.

Stratiotes nymphoides Humb. & Bonpl. ex Willd. *Sp. Pl.* 4: 821. 1806.

Hydrocleys commersoni L.C. Rich. in *Mém. Mus. Hist. Nat.* 1: 368. *pl. 18*. 1815.

In Fiji this species occurs along river banks and in muddy places near water lily ponds. It is a rhizomatous herb with milky juice, yellow petals, and violet or purple stamens.

TYPEFICATION AND NOMENCLATURE: The type of *Stratiotes nymphoides* was collected by Humboldt and Bonpland in or near Caracas, Venezuela, and the holotype is presumably deposited at B. The holotype of *Hydrocleys commersoni* is *Commer-son* (P), obtained near Rio de Janeiro, Brazil.

DISTRIBUTION: Tropical South America; only a single collection, made in 1969, is available from Fiji.

LOCAL NAME AND USE: *Water poppy*; the species is probably a fairly recent introduction, being an attractive ornamental in ponds. However, it is sparingly naturalized in Fiji and can become a serious weed of waterways.

AVAILABLE COLLECTION: VITI LEVU: NAITASIRI: Waimanu River at Adi Cakobau School, *DA 15850*.

FAMILY 8. ALISMATACEAE

ALISMATACEAE Vent. *Tabl. Règne Vég.* 2: 157, as *Alismoideae*. 1799.

Perennial or annual, marsh or aquatic herbs, the leaves basal, submerged or floating or projecting above water, often long-petiolate; inflorescence racemose,

paniculate, or cymose; flowers hermaphrodite or unisexual, the 3 outer perianth segments imbricate, green and sepal-like, the 3 inner ones petaloid, imbricate and deciduous or rarely lacking; stamens hypogynous, 6 or more (rarely 3), the anthers bilocular, extrorse; gynoecium composed of 6-many carpels, these free or rarely united at base, the style persistent, the ovules solitary or rarely more than 1, basal at inner angle of carpel, anatropous; fruit a group of achenes.

DISTRIBUTION: A cosmopolitan family of about 13 genera and 90 species. Only one species is recorded from Fiji.

I. SAGITTARIA L. Sp. Pl. 993. 1753.

Monoecious coarse herbs, often living in shallow water, the leaf blades ribbon-shaped if submerged, ovate if floating, and sagittate if projecting above water surface; inflorescence racemose, the flowers unisexual, the ♂ flowers borne higher than the ♀ flowers, the receptacle large, globose to oblong; inner perianth whorl longer than the outer whorl; stamens numerous; carpels spirally arranged in several series, free from each other to base.

LECTOTYPE SPECIES: *Sagittaria sagittifolia* L., one of Linnaeus's original species (vide Small in N. Amer. Fl. 17: 51. 1909).

DISTRIBUTION: A genus of about 20 species, cosmopolitan but mostly American.

I. *Sagittaria sagittifolia* subsp. *leucopetala* (Miq.) den Hartog in Fl. Males. I. 5: 332. fig. 11, 12. 1957.

Sagittaria sagittifolia var. *leucopetala* Miq. Ill. Fl. Arch. Ind. 49. 1870.

Sagittaria sagittifolia sensu A. C. Sm. in Bull. Torrey Bot. Club 70: 533. 1943; J. W. Parham, Pl. Fiji Isl. 256. 1964, ed. 2. 349. 1972.

As it occurs in Fiji, this taxon is a coarse herb, rooting in mud near sea level and also up to 100 m. elevation, in swamps, marshes, and along rivers in deltas, where it is in standing water at high tide and uncovered at low tide. Its petals are white and its anthers yellow. Flowers and fruits have been obtained in May and July.

TYPIFICATION: For his variety, Miquel cited two specimens, collected by Blume and Junghuhn near Batavia, Java; these may be taken as syntypes.

DISTRIBUTION: The typical variety of Linnaeus's species occurs throughout the temperate Northern Hemisphere. According to den Hartog (1957, cited above), subsp. *leucopetala* is found in southern and eastern Asia and through Malesia. Eastward in the Pacific (Hawaii, Society and Cook Islands) it appears to be an escape from cultivation, and this is probably also the case in Fiji. None of the available collections are very old, and they are all from southeastern Viti Levu, in localities readily available to water plants escaping from ornamental plantings.

LOCAL NAME AND USE: No Fijian name has been reported, and the fact that the tubers are edible has not been noted on any Fijian collection. The species has not been noted in any water garden, but it may exist in Fiji as an ornamental.

AVAILABLE COLLECTIONS: VITI LEVU: NAITASIRE: Sawani, DA, July 4, 1939; Koronivia, DA 3993; Suva Pumping Station, Vaughan 3151. TAILEVU: Wainimbokasi River, Tothill (coll. MacDaniels) 197, MacDaniels 1020. REWA: Near Nausori Bridge opposite Nausori, DA 16635. FIJI without further locality, DA 3483.

Den Hartog points out that subsp. *leucopetala* has pure white petals, yellow anthers, and reflexed sepals, while the European and northern Asian specimens (subsp. *sagittifolia*) have white petals with a purple or carmine basal spot, purple or carmine anthers, and appressed or spreading sepals.

ORDER HYDROCHARITALES

FAMILY 9. HYDROCHARITACEAE

HYDROCHARITACEAE Juss. Gen. Pl. 67, as *Hydrocharides*. 1789.

Salt- or freshwater herbs, usually dioecious, sometimes monoecious, rarely with hermaphrodite flowers, partly or wholly submerged, with terrestrial or floating roots; leaves radical, crowded or dispersed on elongate stems; inflorescence at first enclosed in a bifid spathaceous bract or within 2 opposite bracts; flowers sometimes pollinated below surface of water; perianth-segments 1- or 2-seriate, each series with 3 segments, the outer 3 green, valvate, the inner 3, if present, imbricate, petaloid; ♂ flowers 1 or more than 1 per inflorescence, each with 1-numerous stamens (innermost sometimes sterile), the anthers 2-locular, with longitudinal dehiscence; ♀ flowers solitary, the ovary inferior, 1-locular, usually with 3-6 parietal placentas and several to numerous, orthotropous to anatropous ovules, the styles as many as placentas, entire or 2- or 3-branched; fruits irregularly dehiscent, the seeds numerous, lacking endosperm.

DISTRIBUTION: A widespread family of tropical and temperate water plants, often marine, with 14-16 genera and about 80 species. Two genera are known to occur in Fiji.

KEY TO GENERA

- Plants of freshwater, the leaves verticillate; spathes sessile in leaf axils, composed of 2 bracts connate into a tube; flowers with well-developed petals; stamens 3, opposite outer perianth segments; pollen grains free 1. *Hydrilla*
 Plants of saltwater, the leaves opposite; spathes composed of 2 free bracts; flowers lacking petals; stamens 3, alternate with perianth segments; pollen grains in moniliform chains. 2. *Halophila*

1. *HYDRILLA* L. C. Rich. in Mém. Cl. Sci. Math. Inst. Nat. France **12** (2): 9, 61. 1814; den Hartog in Fl. Males. I. **5**: 385. 1957.

Freshwater, submersed plants; leaves in verticils of 3-8, undifferentiated into petiole and lamina, usually sharply serrate-dentate, less than 4 cm. long; spathes 1-flowered, the flowers unisexual, small, hydrophilous, the perianth segments 2-seriate, the petals subequal to or longer than sepals but narrower; ♂ flowers short-pedicellate, becoming detached and rising to water surface before expanding, the stamens 3; ♀ flowers sessile, the ovary with a stalklike beak, the styles 3, entire.

TYPE SPECIES: *Hydrilla ovalifolia* L. C. Rich., nom. illeg. = *Hydrilla verticillata* (L. f.) Royle (*Serpicula verticillata* L. f.).

DISTRIBUTION: A single species indigenous in Eurasia, Africa, and Australia.

1. *Hydrilla verticillata* (L. f.) Royle, Ill. Bot. Himal. 376. 1839; Greenwood in J. Arnold Arb. **25**: 403. 1944; A. C. Sm. in op. cit. **26**: 97. 1945; Greenwood in op. cit. **36**: 399. 1955; den Hartog in Fl. Males. I. **5**: 385, fig. 1-3. 1957; J. W. Parham in Dept. Agr. Fiji Bull. **35**: 141. 1959, Pl. Fiji Isl. 255. 1964, ed. 2. 349. 1972.

FIGURE 41.

Serpicula verticillata L. f. Suppl. Pl. 416. 1781; Roxb. Pl. Coromandel **2**: 33, t. 164. 1802.

In Fiji this species occurs only near sea level (although noted elsewhere up to 2,000 m.), forming extensive mats in ditches and pools, and also in freshwater rivers and streams, and carried into saltwater bays by floods. It usually has submerged leaves and may occur in rapidly flowing water, rooting in water as deep as 1.5 m. Flowers and fruits probably occur at all seasons, but it is difficult to ascertain whether or not dried specimens are from fertile material.

TIPIFICATION: The younger Linnaeus merely mentioned: "*Habitat* in India." A specimen of *Wallich* ? 5048 in the type cover at K was collected too late to have been seen by Linnaeus.

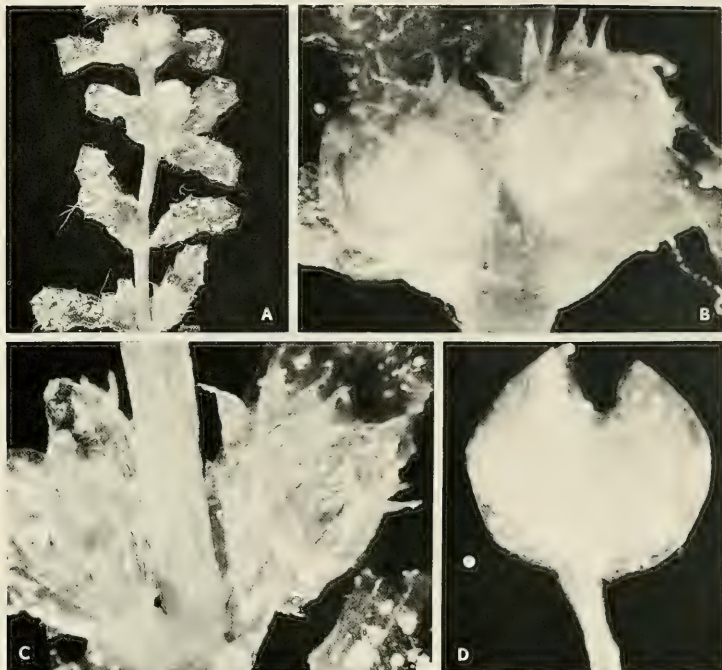


FIGURE 41. *Hydrilla verticillata*, from DA 16032; A, stem with δ inflorescences, the spathes open at lowest node, unopened above, $\times 4$; B, unopened δ spathes, $\times 20$; C, open δ spathes, $\times 20$; D, detached δ flower releasing pollen grains, $\times 20$.

DISTRIBUTION: As of the genus; throughout Malesia but rare in the Moluccas and New Guinea. I have now examined 23 collections from Fiji, all from Viti Levu, but the species is probably a comparatively recent introduction, whether accidental or as an escape from a freshwater aquarium being unknown. The earliest Fijian collection known to me is the one cited by Greenwood in 1944, collected by G. Dennis on Nov. 10, 1942. The species is also known from Guam (*Stone 4468*) but is doubtfully indigenous there.

LOCAL NAME AND USE: *Water weed*. The species has become a very serious weed of many rivers on Viti Levu, especially those of the Rewa system, where it sometimes fouls the propellers of launches and outboard motors; a detailed study of the problem is currently being conducted.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Otuna River, tributary of Nandi River, G. Dennis 955. NANDRONGA & NAVOSA: Navatumali Agriculture Station, DA 16032; Rosikulu, Tangusu Creek, DA 16033. RA: Ndombuilevu Farm, DA 13566. NAITASIRI: Serea, Wainimala River, DA 16629; vicinity of Viria, DA 16610; vicinity of Nanduruloulou, DA 16608; 1 mile up Waimanu River from mouth, DA 16612; Tonga Creek, near Koronivia road, DA 16645. TAILEVU: Malambi, Wainimbuka River, DA 16627; Luvuluvu Creek, left bank of Rewa River, DA 16604; Mbaulevu Landing, DA 16609; Wainimbokasi, DA 16603.

REWA: Opposite Nausori Airport in Rewa River, DA 16657; Lauthala Bay (washed downstream from freshwater), DA L.15601.

The combination *Hydrilla verticillata* is often accredited to Presl, who did not propose it until 1844 (cf. the fuller literature citations I noted in 1945, cited above).

2. HALOPHILA Thou. Gen. Nova Madagasc. 2. 1806; den Hartog in Fl. Males. I. 5: 407. 1957, in Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk., Tweede Sect. 59 (1): 238. 1970.

Dioecious (our species) or monoecious marine plants, usually occurring on coral terraces in shallow water, the rhizome creeping; leaves paired, petiolate, the petioles (in our species) not sheathing, the blades (in our species) elliptic to obovate, the axis of the lateral shoots erect, in our species only slightly developed; spathes of 2 overlapping membranaceous bracts, the flowers solitary, hydrophilous, the perianth segments 3; ♂ flowers pedicellate, with 3 stamens alternating with perianth segments; ♀ flowers essentially sessile, the ovary ellipsoid or ovoid, borne at apex of a long hypanthium surmounted by 3 reduced perianth segments, the styles linear, 3-5; fruit ovoid to globose.

LECTOTYPE SPECIES: *Halophila madagascariensis* Doty & Stone (= *H. minor* (Zoll.) den Hartog) (cf. Sachet & Fosberg in Taxon 22: 441. 1973).

DISTRIBUTION: Eight or ten species in shallow saltwater along coasts of the Indian and Pacific Oceans, and also in tropical and subtropical America.

USEFUL TREATMENTS OF GENUS: Doty, M. S., & B. C. Stone. Typification for the generic name *Halophila* Thours. Taxon 16: 414-418. 1967. Hartog, C. den. The Sea-grasses of the World (in Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk., Tweede Sect. 59 (1)), *Halophila*, 238-268. 1970. Sachet, M.-H., & F. R. Fosberg. Remarks on *Halophila* (Hydrocharitaceae). Taxon 22: 439-443. 1973.

In his definitive work on *Halophila* in 1970 (cited above), den Hartog recognized eight species, placing them in four sections; only sect. *Halophila* occurs in Fiji. Den Hartog recognized the collections from the Fijian Region as representing two subspecies of *H. ovalis*. The discussion by Sachet and Fosberg (1973, cited above) presents cogent reasons for placing these two subspecies in different species, both widespread, and this solution is the one here accepted.

KEY TO SPECIES

- Leaf blades elliptic or oblong-elliptic, 1-4 cm. long, with (9-) 12-25 comparatively spreading secondary nerves ascending at an angle of 37-60°, the areoles not bullate even in mature leaves. . . . 1. *H. ovalis*
 Leaf blades elliptic to obovate, 0.5-2 cm. long, with (3-) 6-12 (-14) secondary nerves sharply ascending at an angle of 65-90°, the areoles (in our area) characteristically bullate, often conspicuously so, but the bullae rarely indistinct or lacking in very young leaves. 2. *H. minor*

1. *Halophila ovalis* (R. Br.) Hook. f. Fl. Tasman. 2: 45. 1858; Christophersen in Bishop Mus. Bull. 128: 6. 1935; den Hartog in Fl. Males. I. 5: 408. fig. 16. 1957; Doty & Stone in Taxon 16: 415. fig. 2. 1967; den Hartog in Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk., Tweede Sect. 59 (1): 240, p. p. 1970.

FIGURES 25 (upper), 42A.

Caulina ovalis R. Br. Prodr. Fl. Nov. Holl. 339. 1810.

Halophila ovalis subsp. *ovalis*; den Hartog in Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk., Tweede Sect. 59 (1): 251. 1970.

Halophila ovalis var. *ovalis*; J. W. Parham, Pl. Fiji Isl. ed. 2. 349. 1972.

In Fiji the typical subspecies of *Halophila ovalis* (if the species is finally recognized as composed of several subspecies) occurs on sandy mudflats which are exposed at low tide, typically offshore where mangroves occur, and often associated with *Halodule pinifolia*. It has not been observed on coarse rocky reefs where

Halophila minor occurs. It is found in copious mats, or sometimes more dispersed, with spreading, elongate stems. Probably it is in flower and fruit throughout much of the year, but this is not readily observed.

TYPEIFICATION: The type is *R. Brown 5816* (number added by Bennett), collected Sept. 24, 1802, at the inner entrance to Thirsty Sound, Queensland, Australia (BM HOLOTYPE; ISOTYPE at K). Although den Hartog indicated "locality unknown" for Brown's collection, Dr. W. T. Stearn kindly located the above data for me in Brown's notes; the locality is described in Stearn's introduction to the facsimile edition of the *Prodromus* as "station 23."

DISTRIBUTION: According to den Hartog's 1970 treatment, the typical subspecies of *Halophila ovalis* occurs from eastern Africa and Madagascar through the Indian Ocean and Red Sea and through Malesia, extending northward to Japan, southward to Tasmania, and eastward to Tonga and Samoa. The Hawaiian collections cited by den Hartog as subsp. *hawaiiiana* are considered specifically distinct as *H. hawaiiiana* Doty & Stone by Sachet and Fosberg (in *Taxon* 22: 443. 1973). In Fiji this species is less common than *H. minor*. Both species also occur in Samoa, but all the Tongan material I have seen may be referred to *H. minor*; however, it is quite possible that *H. ovalis* is also to be found in Tonga.

AVAILABLE COLLECTIONS: VITI LEVU: Moseley, Aug. 1874, p. p. VANUA LEVU: THAKAUNDROVE: Nasinu, Natewa Bay, DA 16870; Tukavesi, Mbutha Bay, DA 16896. Den Hartog in 1970 cited Smith 9620 as representing the typical subspecies; however, my no. 9620 was collected as *Halodule pinifolia*, with which a few leaves of *Halophila* are often mixed. In this case the *Halophila* was collected by me as no. 9619, which I believe to represent *H. minor*.

2. *Halophila minor* (Zoll.) den Hartog in Fl. Males. I. 5: 410. fig. 17, b. 1957; Sachet & Fosberg in *Taxon* 22: 441. 1973. FIGURES 25 (lower), 42B.

Lemnopsis minor Zoll. Syst. Verz. 1: 75. 1854.

Halophila ovata sensu auct. incl. den Hartog in Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk., Tweede Sect. 59 (1): 251. 1970; non Gaud. 1826, 1827, 1829 (nom. illeg. = *H. ovalis*).

Halophila ovalis var. *bullosa* Setchell in Carnegie Inst. Wash. Publ. 341: 114. fig. 6. 1924; Yuncker in Bishop Mus. Bull. 220: 52. 1959; J. W. Parham, Pl. Fiji Isl. ed. 2. 349. 1972.

Halophila ovalis sensu Greenwood in Proc. Linn. Soc. 154: 104. 1943; Yuncker in Bishop Mus. Bull. 220: 51. 1959; J. W. Parham, Pl. Fiji Isl. 255. 1964; non Hook. f.

Halophila ovalis subsp. *bullosa* den Hartog in Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk., Tweede Sect. 59 (1): 251. 1970.

In Fiji *Halophila minor* is found on reefs, usually in coarse sand in shallow pools exposed at low tide; it is often seen in dense pure stands where slightly covered or barely exposed at low tide, but sometimes it is associated with *Halodule pinifolia*. Flowering and fruiting material is seldom observed but is probably available throughout the year to a careful searcher.

TYPEIFICATION AND NOMENCLATURE: The type of *Lemnopsis minor* is Zollinger 3334 (HOLOTYPE perhaps at BR), collected near Bari, Flores, on July 12, 1847. In proposing *Halophila ovalis* var. *bullosa*, Setchell cited his numbers 114, 115, and 181, all from Tutuila, Samoa, and also U.S. Expl. Exped. Of these, den Hartog in 1970 cited only no. 114, not making a lectotypification; however, Sachet and Fosberg in 1973 cited Setchell 114 as the type, and I consider that they have thus definitely selected a lectotype (at UC; ISOLECTOTYPES at BISH, US). The number was collected at Aua on June 12, 1920. There has been considerable disagreement regarding the appropriate name for this taxon, for the details of which the reader is referred to the discussion of Sachet and Fosberg. In 1957 den Hartog had proposed the combination *H. minor* on the assumption that *H. ovata* Gaud. was a superfluous name, because *Caulina ovalis* R. Br. had been cited in the synonymy. However, in

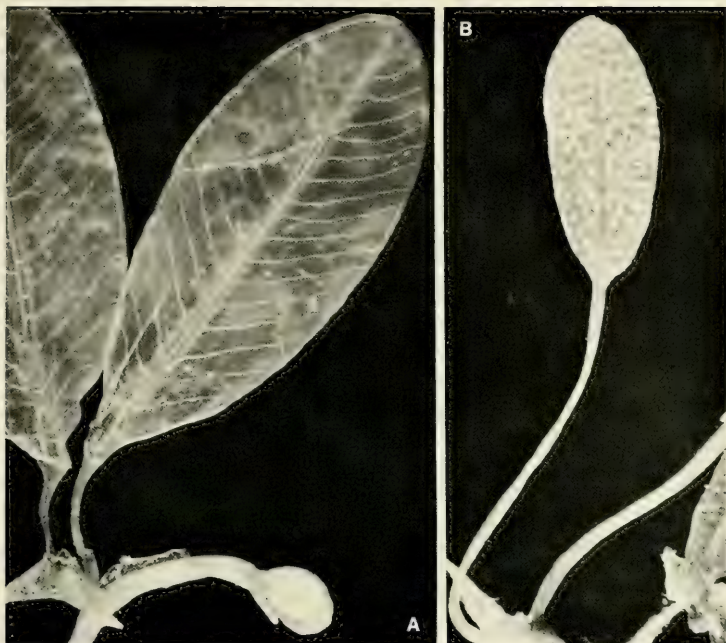


FIGURE 42. A, *Halophila ovalis*, leaves and stem tip, $\times 4$, from DA 16896. B, *Halophila minor*, leaf and portions of stem, $\times 4$, from DA 16903.

1970 he changed his mind and accepted *H. ovata*. The clarification of Sachet and Fosberg makes it apparent that den Hartog was correct in 1957. A second question is whether *H. ovalis* var. *bullosa* Setchell should be placed in *H. ovalis* or in *H. minor*. I am disposed to agree with Sachet and Fosberg in reducing the variety outright to *H. minor*, the degree of leaf bullation being less dependable than the size of leaves and the comparatively few secondary nerves that ascend at a sharp angle.

DISTRIBUTION: Widely distributed from eastern Africa and Madagascar along shores of southeastern Asia and through Malesia to the Mariana Islands and Australia, and eastward to Samoa and Tonga. In Fiji this seems the more frequent of the two species of *Halophila* occurring there.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Sawani Beach, near Lautoka, *Greenwood* 831. SERUA: Fringing reefs in vicinity of Ngaloa, *Smith* 9619; between Ngaloa and Wainiyambia, *DA* 16811. REWA: Vicinity of Suva, *Setchell & Parks* 17758, *DA* 16485; Lauthala Bay, *DA* L15603; Rewa River area, *Moseley*, Aug. 1874, p. p. VANUA LEVU: THAKAUNDROVE: Ndevandaro, *DA* 16867. TAVEUNI: Waiyevo, *DA* 16903.

Halophila is unbelievably abundant in Fiji and is perhaps represented there by a greater number of individual plants than any other phanerogam (except possibly

Halodule); one becomes aware of this when flying at low elevation over areas of shallow water offshore and between islands. The complex shallow reef system between Viti Levu and Vanua Levu, for instance, is seen to be literally green with masses of *Halophila* plants. The collections of marine phanerogams in the *DA 16000* series were obtained during brief excursions by J. W. Parham, P. B. Tomlinson, and myself in 1969, Dr. Tomlinson being anxious to obtain material of such phanerogams for anatomical study. In our observations we noted that the two kinds of *Halophila* (here referred to different species) do not occur together, although each may be associated with *Halodule pinifolia*. In general, *Halophila minor* is the more abundant and occurs in coarse sand and on rocky limestone reefs, while *H. ovalis* is more likely to be found in muddy areas near mangrove swamps. Our observations, of course, were not conclusive, but at this time I am inclined to believe that the two taxa are specifically distinct. It is probable that Moseley's mixed collection, made during the *Challenger* expedition, was obtained at more than one locality.

ORDER POTAMOGETONALES

KEY TO FAMILIES OCCURRING IN FIJI

Flowers hermaphrodite (in our families), in spikes.

Perianth of 4 short-clawed segments; stamens 4, inserted on perianth segment claws; carpels 4, sessile, free; plants of freshwater. 10. POTAMOGETONACEAE

Perianth lacking; stamens 2; carpels 4 or more; plants of brackish streams and marshes. 11. RUPPIACEAE

Flowers unisexual, without a perianth, terminal on a short branch or in a cymose inflorescence, the pollen threadlike; submerged marine plants. 12. CYMODOCEACEAE

FAMILY 10. POTAMOGETONACEAE

POTAMOGETONACEAE Dumort. Anal. Fam. Pl. 59, 61, as *Potamogetoneae*. 1829.

Freshwater aquatic herbs, the leaves alternate or opposite, immersed or above water, sheathing at base; flowers ♀, in pedunculate axillary spikes, the perianth of 4 free, rounded, short-clawed, valvate segments; stamens 4, inserted on the perianth segment claws, the anthers sessile, 2-locular, extrorse; carpels 4, sessile, free, 1-locular, the styles short or none, the ovule solitary, attached to the adaxial angle of the carpel, campylotropous; fruiting carpels free, indehiscent, the seeds without endosperm.

DISTRIBUTION: A cosmopolitan family of two genera and about 100 species, all except one belonging in the genus *Potamogeton*.

1. POTAMOGETON L. Sp. Pl. 126. 1753; Aschers. & Graebn. in Pflanzenr. 31 (IV. 11): 39. 1907.

Characters of the family; rhizome creeping, sympodial, the branches erect, leafy, the leaves alternate; fruiting carpels drupaceous, with a hard endocarp and soft exocarp.

LECTOTYPE SPECIES: *Potamogeton natans* L. (vide N. Taylor in N. Amer. Fl. 17 (1): 14. 1909), one of Linnaeus's original twelve species.

DISTRIBUTION: Cosmopolitan, with about 100 species. Only one species has been recorded from Fiji.

1. *Potamogeton crispus* L. Sp. Pl. 126, as *P. crispum*. 1753; Aschers. & Graebn. in Pflanzenr. 31 (IV. 11): 97. fig. 23. 1907; J. W. Parham, Pl. Fiji Isl. ed. 2. 350. 1972.

FIGURE 43.

The only species of *Potamogeton* known to occur in Fiji is a naturalized weed in low elevation ponds and rivers, sometimes carried into saltwater bays by floods. It is a submerged herb, sometimes rooting at depths as much as 3 m., or found at the edges of fast-flowing streams and rivers, often in thick beds, and often associated with *Hydrilla verticillata*. The flowers are white and, with the fruits, may be expected throughout the year.

TYPIFICATION: Giving several prior references, Linnaeus indicates that *Potamogeton crispus* is a European species.

DISTRIBUTION: *Potamogeton crispus* is probably indigenous in many parts of the Old World, especially in tropical areas; it is now widespread, presumably as an accidental introduction into various countries or as an escape from aquaria or water gardens. It had probably been present in Fiji for some time prior to the first published record of its occurrence there, in 1972. About 20 Fijian collections are now at hand, all from eastern Viti Levu.

LOCAL NAMES AND USE: *River weed*; elsewhere the name *curled pondweed* has been used. Like *Hydrilla verticillata*, *Potamogeton crispus* has become a serious weed, especially in the Rewa River system, because of its tendency to become entangled in the propellers of small boats.



FIGURE 43. *Potamogeton crispus*, from DA 14527; A, apical portion of stem with foliage and a long-pedunculate inflorescence, $\times 2$; B, distal portion of an inflorescence, $\times 10$.

REPRESENTATIVE COLLECTIONS: VITI LEVU: NAITASIRI: Nambukaluka, Waindina River, *DA 16631*; Nanggali, Waindina River, *DA 16630*; Nanduruloulou, Rewa River, *DA 14527*; near Vatuvula, Waimanu River, *DA 16613*; Tonga River near Koronivia, *DA 11543*. TAILEVU: Malambi, Wainimbuka River, *DA 16626*; Waimbula River, *DA 16623*; Wainivesi River, *DA 16622*; Wainimbokasi, *DA 16602*. REWA: Tonga River, *DA 11828*; Lauthala Bay (washed downstream from freshwater), *DA L.15599*.

FAMILY 11. RUPPIACEAE

RUPPIACEAE Hutchinson, Fam. Fl. Pl. 2: 48. 1934.

Submerged, slender, aquatic herbs of brackish streams and marshes, the leaves opposite or alternate, linear, sheathing at base; flowers ♂, small, in short, terminal, subumbellate racemes, the perianth absent; stamens 2, opposite, with short, broad filaments and extrorse anthers, the locules reniform, separated by the connective; carpels 4 or more, free, the stigmas peltate or umbonate, the ovule solitary, pendulous, campylotropous; fruiting carpels usually long-stipitate, indehiscent, the seeds pendulous, without endosperm.

DISTRIBUTION: A single genus of temperate and tropical areas, composed of three or perhaps a greater number of species.

1. *RUPPIA* L. Sp. Pl. 127. 1753; Aschers. & Graebn. in Pflanzenr. 31 (IV. 11): 142. 1907.

Characters of the family.

TYPE SPECIES: *Ruppia maritima* L., the only original species.

DISTRIBUTION: Of the family. In Fiji and most other parts of the Pacific a variety of *Ruppia maritima* is probably the sole representative, but different species apparently occur in Australia and New Zealand (Davis & Tomlinson in J. Arnold Arb. 55: 59-66. 1974).

1. *Ruppia maritima* var. *pacifica* St. John & Fosberg in Occas. Pap. Bishop Mus. 15: 176. 1939; Yuncker in Bishop Mus. Bull. 220: 51. 1959; J. W. Parham, Pl. Fiji Isl. ed. 2. 350. 1972.

FIGURE 44.

Ruppia maritima sensu Greenwood in Proc. Linn. Soc. 154: 104. 1943, in J. Arnold. Arb. 25: 402. 1944; J. W. Parham, Pl. Fiji Isl. 257. 1964.

The only member of the genus occurring in Fiji is found in brackish estuaries and in ponds or streams of brackish water, from which it is often carried into bays of saltwater by floods. It is a submerged herb, usually found in water about 1 m. deep at high tide and often uncovered at low tide. Fruits have thus far been noted only in March and May.

TYPIFICATION: The holotype of the variety is *Fosberg 14038* (BISH; ISOTYPES at K, US), collected June 13, 1937, in a brackish estuary at Kailua Beach, Oahu, Hawaii.

DISTRIBUTION: Although *Ruppia maritima* is essentially worldwide, its var. *pacifica* occurs from Hainan and the Philippines to Polynesia, including Hawaii. Our material, known only from Viti Levu, belongs to f. *pacifica*; another form, f. *curvirostris*, was described by St. John and Fosberg from Hainan and the Philippines, although their typical form is also cited from those areas.

AVAILABLE COLLECTIONS: VITI LEVU: RA: Penang, *Greenwood 748*. TAILEVU: Wainimbokasi, *DA L.15605*. REWA: Right bank of Rewa River opposite Naililili, *DA 16601, 16633*; Rewa estuary, *Guppy*, in 1899. Greenwood (1944, cited above) also reported *Ruppia maritima* from the Singatoka district, Nandronga & Navosa Province, but apparently he did not prepare a specimen.



FIGURE 44. *Ruppia maritima* var. *pacifica*, from DA 16633; A, leaf tip, $\times 20$; B, fruiting carpels, $\times 6$; C, a fruiting carpel, $\times 20$.

FAMILY 12. CYMODOCEACEAE

CYMODOCEACEAE N. Taylor in N. Amer. Fl. 17 (1): 31. 1909.

Potamogetonaceae subfam. *Cymodoceoideae* den Hartog in Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk., Tweede Sect. 59 (1): 144. 1970.

Dioecious, perennial, submerged marine plants, the rhizome creeping, in our genera herbaceous, monopodial, rooting at nodes, the leaves distichous, sheathing at base, with linear or subulate blades; flowers without a perianth, either terminal on a short branch or in a cymose inflorescence; σ flowers subsessile or stalked, consisting of 2 quadrilocular, extrorsely dehiscent anthers, these partially dorsally connate, the pollen threadlike; ρ flowers sessile or short-stalked, consisting of 2 free ovaries, the ovule solitary, suborthotropous, pendulous; fruit (in our genera) more or less compressed, with a stony pericarp, the seed solitary.

DISTRIBUTION: Five genera with about 16 species, mostly tropical but extending into subtropical and warm temperate waters.

USEFUL TREATMENT OF FAMILY: Hartog, C. den. *Potamogetonaceae* subfam. *Cymodoceoideae*. The Sea-grasses of the World (in Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk., Tweede Sect. 59 (1)), 144-212. 1970.

The Cymodoceaceae are accepted as a separate family by Takhtajan, Airy Shaw (in Willis, Dict. Fl. Pl. Ferns, ed. 7. 320. 1966), and other authors, but have been variously combined with Zosteraceae (e. g. Cronquist, Evol. Class. Fl. Pl. 372. 1968), Potamogetonaceae (e. g. den Hartog, cited above), or Zannichelliaceae (e. g. Hutchinson, Fam. Fl. Pl. ed. 3. 689. 1973) by others.

KEY TO GENERA

- Leaves flat, 3-nerved; flowers solitary; anthers attached at different levels; ovaries with a long, undivided style. 1. *Halodule*
 Leaves subulate; flowers in a cymose inflorescence; anthers attached at the same level; ovaries with a short style divided into 2 short stigmas. 2. *Syringodium*

1. *HALODULE* Endl. Gen. Pl. 1368. 1841; den Hartog in Blumea **12**: 296. 1964, in Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk., Tweede Sect. **59** (1): 146. 1970.

Diplanthera Thou. Gen. Nova Madagasc. 3. 1806; Aschers. & Graebn. in Pflanzenr. **31** (IV. 11): 151. 1907; non Gled. (1764).

Rhizome with 2 vascular bundles in the cortical layer; leaf blades linear, the nerves 3, the midrib conspicuous, the lateral nerves inconspicuous, each ending in a lateral tooth; flowers solitary, terminal, enclosed in a leaf similar to other leaves; anthers of ♂ flower attached at different levels; ♀ flowers sessile, each ovary with a long, undivided style; fruit subglobose-ovoid, somewhat compressed, with a short beak.

TYPE SPECIES: *Halodule tridentata* (Steinheil) Endl. ex Unger (*Diplanthera tridentata* Steinheil) = *H. uninervis* (Forssk.) Aschers. *Halodule* is a substitute name for *Diplanthera* Thou. (non Gleditsch).

DISTRIBUTION: Den Hartog (in 1970, cited above) recognizes six species, the genus being widely distributed along the coasts of all tropical seas. Two species occur in Fiji and Tonga, but they have been confused with one another and sometimes also with *Syringodium*.

KEY TO SPECIES

- Leaves (in Fijian specimens) 2.5–3.5 mm. broad, with well-developed lateral teeth at apex, the median tooth inconspicuous and without secondary teeth. 1. *H. uninervis*
 Leaves (in Fijian specimens) 0.5–1 mm. broad, the lateral teeth at apex only faintly developed or absent. 2. *H. pinifolia*

1. *Halodule uninervis* (Forssk.) Aschers. in Boiss. Fl. Orient. **5**: 24. 1882, in Engl. & Prantl, Nat. Pflanzenfam. II. **1**: 213. 1889; den Hartog in Blumea **12**: 297. fig. 1–3. 1964, in Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk., Tweede Sect. **59** (1): 147. 1970. FIGURE 45A.

Zostera uninervis Forssk. Fl. Aegypt.-Arab. CXX, 157. 1775.

Halodule australis Miq. Fl. Ned. Ind. **3**: 227. 1856; Aschers. in Linnaea **35**: 163, 187–189, p. p. 1868.

Diplanthera uninervis Aschers. in Engl. & Prantl, Nat. Pflanzenfam. Nachtr. **1**: 37. 1897; Aschers. & Graebn. in Pflanzenr. **31** (IV. 11): 152. 1907; Yuncker in Bishop Mus. Bull. **220**: 51, p. p. 1959.

Of the two species of *Halodule* occurring in Fiji, this is the less frequent; it has been found with certainty only in shallow water in the lagoon of Fulanga.

TYPEFIICATION AND NOMENCLATURE: No type specimen was cited in the original publication of *Zostera uninervis*; den Hartog in 1970 did not cite a type for either this or for *Halodule australis*. The latter is mentioned above only because Greenwood (in J. Arnold Arb. **25**: 402. 1944) listed it as a synonym of *Diplanthera uninervis*, although his report actually refers to *Syringodium*.

DISTRIBUTION: Widely distributed along the coasts of the Indian Ocean from the Red Sea to southern Africa, eastward through southeastern Asia and Malesia, northward to Japan and the Mariana Islands, southward to Australia, and into the Pacific to Fiji and Tonga.

AVAILABLE COLLECTION: FULANGA: Muanaithake, *DA 17824*.

Den Hartog (in 1970, cited above) correctly states that earlier reports of this species in Fiji have been erroneous for *Syringodium*. The report from Tonga, however, is correct, the only Tongan collection I have verified (*Yuncker 15288*) being a mixture of *Halodule uninervis* and *H. pinifolia*. The above cited Fulanga collection, made in 1971 by G. B. K. Baines, definitely represents *H. uninervis*.

2. ***Halodule pinifolia*** (Miki) den Hartog in *Blumea* **12**: 309. *fig. 10*. 1964, in Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk., Tweede Sect. **59** (1): 158. *fig. 44*. 1970; J. W. Parham, Pl. Fiji Isl. ed. 2. 350. 1972. FIGURES 25 (upper), 45B.

Diplanthera pinifolia Miki in Bot. Mag. (Tokyo) **46**: 787. *fig. 9*. 1932, in op. cit. **48**: 132, 135. 1934.

Diplanthera uninervis sensu Yuncker in Bishop Mus. Bull. **220**: 51, p. p. 1959; non Aschers.

The more common species of *Halodule* in Fiji occurs in great abundance in the upper part of the littoral belt on coral sand, in tide pools on reefs, and also on mud-flats off mangrove-lined shores. It forms dense mats or has elongate stems and frequently occurs in association with either species of *Halophila* known from Fiji. Usually it is either covered by shallow water at low tide or is exposed for a short period.

TYPEIFICATION: In 1932 Miki cited three of his own collections, unnumbered but made in 1925 at Takao, Taiwan, and in 1930 on Hanijimura and Yonagusuku in the Ryukyus. As far as I can ascertain, neither den Hartog nor Walker (Fl. Okinawa & S. Ryukyu Isl. 147. 1976) has chosen a lectotype.

DISTRIBUTION: Widely distributed in the western Pacific area from the Ryukyu Islands, Taiwan, and southeastern Asia through Malesia to Queensland, and eastward to Fiji and Tonga.

AVAILABLE COLLECTIONS: VITI LEVU: SERUA: Vicinity of Ngaloa, *Smith 9620*; between Ngaloa and Wainiyambia, *DA 16812*. REWA: Suva and vicinity, *Setchell & Parks 17739*, *DA 16484*; Lauthala Bay, *DA L.15600*. VANUA LEVU: THAKAUNDOVE: Ndevandaro, *DA 16868*; Nasinu, Natewa Bay, *DA 16871*; Tukavesi, Mbutha Bay, *DA 16897*. TAVEUNI: Waiyevo, *DA 16902*. FIJI without further locality, *DA 13264*.

2. **SYRINGODIUM** Kütz. in Hohenack. Alg. Marin. Sicc. **9**: no. 426. 1860; Dandy & Tandy in J. Bot. **77**: 116. 1939; den Hartog in Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk., Tweede Sect. **59** (1): 176. 1970.

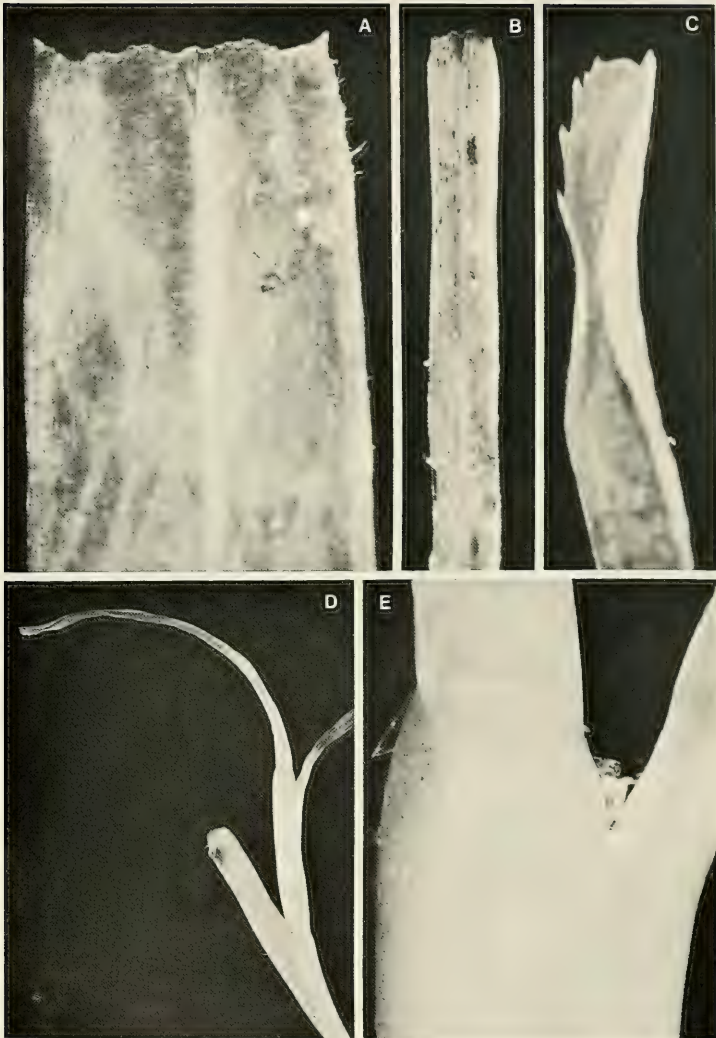
Cymodocea sect. *Phycoschoenus* Aschers. in *Linnaea* **35**: 162. 1867.

Cymodocea subgen. *Phycoschoenus* Aschers. in Aschers. & Graebn. in *Pflanzenr.* **31** (IV. 11): 149. 1907.

Rhizome with many vascular bundles in the cortical layer; leaf blades subulate, with 1 central vascular bundle, 6–8 air channels, and a number of parietal vascular bundles; flowers in a cymose inflorescence, each flower enclosed in a reduced leaf; anthers of ♂ flower attached at the same level; ♀ flowers sessile, each ovary with a short style divided into 2 short stigmas; fruit obliquely ellipsoid to obovoid, quadrangular in cross section, the beak short and bifid.

TYPE SPECIES: *Syringodium filiforme* Kütz.

DISTRIBUTION: Two closely related species, one in the Indo-Pacific area and one in tropical America and northward to Louisiana and Florida.



1. *Syringodium isoetifolium* (Aschers.) Dandy in J. Bot. 77: 116. 1939; Yuncker in Bishop Mus. Bull. 220: 50. 1959; J. W. Parham, Pl. Fiji Isl. 257. 1964, ed. 2. 350. 1972; den Hartog in Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk., Tweede Sect. 59 (1): 177. fig. 50, 51. 1970. FIGURE 45C-E

Cymodocea isoetifolia Aschers. in Sitzungsber. Ges. Naturf. Freunde Berlin 1867: 3. 1867, in Linnaea 35: 163. 1867; Engl. in Bot. Jahrb. 7: 446. 1886; Aschers. & Graebn. in Pflanzenr. 31 (IV. 11): 149. 1907.

Diplanthera uninervis sensu Greenwood in J. Arnold Arb. 25: 402. 1944; A. C. Sm. in op. cit. 26: 97. 1945; J. W. Parham, Pl. Fiji Isl. 257. 1964; non Aschers.

Halodule uninervis sensu J. W. Parham, Pl. Fiji Isl. ed. 2. 350. 1972; non Aschers.

As it occurs in Fiji, this marine herb forms clumps or has stems elongate to 50 cm. or more, sometimes occurring on mudflats exposed at low tide and sometimes on the outer parts of fringing reefs and not exposed at low tide; it is often abundant in beach drift and is seldom collected in flowering condition.

TYPEIFICATION: The type is probably best considered *Wight 2413* ("*Cymodocea aequorea* var. *Wight*"), collected near Galle, Ceylon.

DISTRIBUTION: Coasts of the Indian Ocean from the Red Sea to eastern Africa and Madagascar, eastward to southeastern Asia, the Ryukyu Islands, and Australia, throughout Malesia, and into the Pacific to Fiji, Tonga, and Samoa.

AVAILABLE COLLECTIONS: VITI LEVU: NANDRONGA & NAVOSA: Thuvu Beach, *Greenwood 927, 927B*; Tumbakula, near Korotongo, *V. J. Chapman*, May 11, 1967. SERUA: Ndeumba, *DA 16579*; Naitonitoni Beach, *Greenwood 927A*. REWA: Vicinity of Suva, *Setchell 15172, DA 16486*. VITI LEVU without further locality, *Parks 17809*. VANUA LEVU: THAKAUNDROVE: Ndevandaro, *DA 16869*. FULANGA: Muani-thake, *DA 17821*.

SUBCLASS LILIIDAE

KEY TO ORDERS OCCURRING IN FIJI

Gynoecium composed of several to many free carpels, the ovule solitary, basal, the mature seeds with well-developed endosperm; flowers usually unisexual, actinomorphic, the perianth segments 1-seriate, valvate, equal or subequal; stamens 2-6; leafless saprophytic herbs, terrestrial, mycotrophic.

TRIURIDAE (FAMILY 13)

Gynoecium composed of 1 carpel or 2 or 3 united carpels.

Perianth predominantly actinomorphic but sometimes slightly zygomorphic; ovary superior or inferior; plants not mycotrophic; seeds with copious endosperm.

Perennial herbs with rhizomes, corms, bulbs, or tubers, sometimes aquatic, sometimes climbing, sometimes woody or arborescent; inflorescence various, the flowers solitary or in terminal clusters or racemes or umbels or cymes or panicles, hermaphrodite or unisexual; perianth often corollalike, rarely slightly zygomorphic, the 2 series of segments often similar and sometimes fusing together in a single tube, a corona sometimes present; stamens often 6 (but sometimes fewer and rarely as many as 18); ovary superior to inferior; fruit a capsule or berry.

LILIALES (FAMILIES 14-23)

Perennial herbs usually with corms, sometimes with rhizomes or bulbs, terrestrial; inflorescence not umbelliform, the flowers hermaphrodite, borne within floral sheaths, these solitary or combined; perianth petaloid, sometimes slightly zygomorphic; stamens 3; ovary inferior (very rarely superior), the style arms sometimes petaloid; fruit a loculicidally dehiscent capsule.

IRIDAE (FAMILY 24)

Perianth composed of 2 separate whorls, zygomorphic, usually obviously so; ovary inferior.

Plants terrestrial, rhizomatous, often very large, rarely with woody stems, not mycotrophic; mesophytes with penninerved, often broad leaf blades; zygomorphy of flowers sometimes not extremely obvious; stamens basically 5 or 6 but sometimes only 1 fertile (and this sometimes 1-locular) and others staminodial and sometimes petaloid; seeds with endosperm, often arillate.

ZINGIBERALES (FAMILIES 25-31)

FIGURE 45. A, *Halodule uninervis*, tip of leaf, $\times 20$, from *DA 17824*. B, *Halodule pinifolia*, tip of leaf, $\times 20$, from *DA 16902*. C-E, *Syringodium isoetifolium*, from *DA 16486*; C, tip of leaf, $\times 20$; D, part of erect stem and leaves, $\times 2$; E, distal portion of leaf sheath, $\times 20$.

Plants terrestrial or epiphytic or saprophytic, strongly mycotrophic, sometimes without chlorophyll; flowers strongly zygomorphic; stamens 1 or 2; seeds very numerous and minute, essentially without endosperm, the embryo undifferentiated. ORCHIDALES (FAMILY 32)

ORDER TRIURIDALES

FAMILY 13. TRIURIDACEAE

TRIURIDACEAE Gardner in Trans. Linn. Soc. **19**: 160, as *Triuraceae*. 1843.

Leafless saprophytic herbs, usually monoecious or dioecious, rarely with hermaphrodite flowers, the stems with a few inconspicuous scales; inflorescence racemose or subcorymbose, the flowers actinomorphic, small, the receptacle flat or convex, the perianth segments 3–10, petaloid, 1-seriate, valvate, equal or subequal, often with an apical knob or cauda; ♂ flowers with 2–6 stamens, the filaments short, the anthers 2- or 4-locular, often transversely dehiscent, the connective sometimes produced into a subulate appendage; ♀ flowers rarely with staminodes, the carpels several to many, free, 1-locular, the style terminal to subbasal, the ovule solitary, basal from inner angle, anatropous; fruiting carpels crowded, each dehiscing by a longitudinal slit, the seed erect, with copious endosperm.

DISTRIBUTION: A family of about 7 genera and 80 species, occurring in the tropical areas of both hemispheres.

USEFUL TREATMENT OF FAMILY: Giesen, H. *Triuridaceae*. *Pflanzenr.* **104** (IV. 18): 1–84. 1938.

The family has been considered sufficiently isolated to be placed in its own order, which shows affinities to both the subclasses Liliidae and Alismatidae.

1. *ANDRURIS* Schlechter in Bot. Jahrb. **49**: 71. 1912; Giesen in *Pflanzenr.* **104** (IV. 18): 15. 1938; A. C. Sm. in J. Arnold Arb. **36**: 274. 1955.

Monoecious, saprophytic plants, the stem bearing bract-subtended flowers in a distal raceme, the lower pedicels often elongate, the perianth segments usually 6; ♂ flowers with 3 stamens, the connective produced into a subulate appendage; ♀ flowers with 15–25 carpels crowded into a compact head, the style filiform.

TYPE SPECIES: Schlechter originally included three species without designating a type species; none was indicated by Giesen and apparently no ING card has proposed a selection.

DISTRIBUTION: Fifteen or 16 species distributed in Indo-Malesia, northward to Japan and Micronesia, southward to tropical Australia, and eastward to New Caledonia and Fiji, where the range of the genus and family terminates with one endemic species.

1. *Andruris vitiensis* (A. C. Sm.) Giesen in *Pflanzenr.* **104** (IV. 18): 28. 1938; A. C. Sm. in *Sargentia* **1**: 5. 1942, in Bull. Torrey Bot. Club **70**: 534. 1943, in J. Arnold Arb. **36**: 274. 1955; J. W. Parham, Pl. Fiji Isl. 257. 1964, ed. 2. 349. 1972.

FIGURE 46.

Sciaphila vitiensis A. C. Sm. in Bishop Mus. Bull. **141**: 15. fig. 5. 1936.

The single Fijian species of *Andruris* has been infrequently collected in forest between 30 and 429 m. It is a saprophytic herb 8–15 cm. high, inconspicuously growing in leaf mold, the entire plant (including bracts, pedicels, perianth, etc.) at first being purplish and at length becoming straw-colored. Flowers have been obtained in April, June, and August.

TYPIFICATION: The type is *Smith 1486* (HOLOTYPE at BISH; many ISOTYPES), collected in flower and fruit April 2, 1934, in the northern limestone section of Vanua Mbalavu.

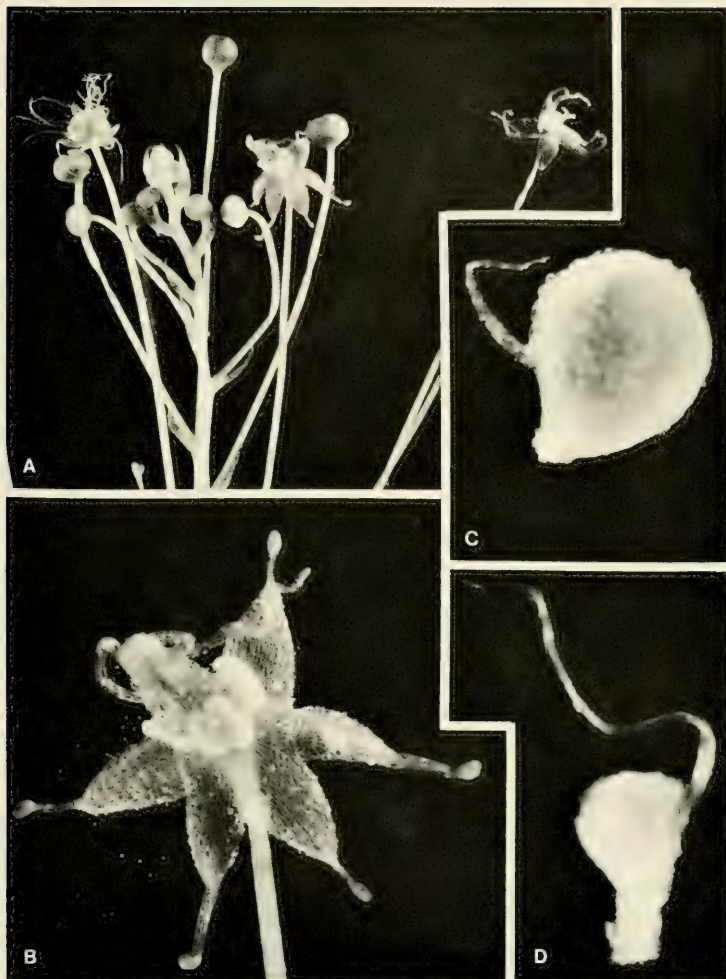


FIGURE 46. *Andruris vitiensis*; A, tip of inflorescence, with δ and γ flowers, $\times 6$; B, δ flower, showing knobbed perianth segments and anthers with connectives produced into subulate appendages, $\times 20$; C, essentially mature carpel, showing lateral style and line of ultimate dehiscence, $\times 40$; D, carpel at anthesis, showing lateral style, $\times 70$; A & B from DA 16523, C & D from Smith 1486.

DISTRIBUTION: Endemic to Fiji and thus far known only from Viti Levu, Vanua Levu, and Vanua Mbalavu. Probably it is more abundant than the few available collections indicate, but it is easily overlooked.

AVAILABLE COLLECTIONS: VITI LEVU: NAMOSI or REWA: Near Queen's Road between Waindoui River and Wainamboro Creek, *Vaughan 3342*. REWA: Upper slopes of Mt. Korombamba, *Gillespie 2352, DA 1141, 16523*. VAUNA LEVU: MATHUATA: Hills along coast, *Greenwood 669*.

ORDER LILIALES

Few angiosperm orders have been subject to as much disagreement, as to scope and included taxa, as the Liliales. The few families of it that occur in Fiji have been placed in six different orders by Hutchinson, while the exclusiveness or inclusiveness of the concerned families varies among specialists to the point of distraction. In order to preserve the sequence of families proposed by Takhtajan the following key has been devised, but the user would be well advised to consult a strictly artificial key to families, with double-keying to place aberrant genera.

KEY TO FAMILIES OCCURRING IN FIJI

Flowers actinomorphic or essentially so; plants (at least in our genera) not aquatic.

Leaf blades usually narrow and parallel-veined or curvinerved and essentially without a petiole, or reduced to often minute scales, or, if broader and having the main veins connected by cross veins, then the petiole short.

Leaves not reduced to scales.

Erect herbs or, if climbing, then ascending by means of coiled tendrils terminating the upper leaves.

Flowers variously arranged; corona lacking.

Plants not xerophytic or only slightly so, rarely soft-woody; leaves not fibrous; flowers hermaphrodite or unisexual; ovary superior; style sometimes divided.

Inflorescence various but not umbellate, not scapose; leaves not fistular. . . . 14. LILIACEAE

Inflorescence umbellate, scapose; leaves linear or fistular. 15. ALLIACEAE

Plants usually xerophytic, rhizomatous, often woody or arborescent; leaves often thick or fleshy, fibrous, often crowded at or near base of stem; flowers (in our genera) hermaphrodite; ovary superior or inferior; style simple. 16. AGAVACEAE

Flowers in pedunculate umbels, these involucre at base on leafless peduncles usually arising from a tunicated bulb; corona often present; flowers (in our genera) hermaphrodite; ovary (in our genera) inferior. 17. AMARYLLIDACEAE

Climbing shrubs or sprawling vines (our genus); flowers hermaphrodite; ovary superior.

18. PHILESIACEAE

Leaves reduced to scariose and often minute scales bearing modified branchlets (cladophylls) in their axils; flowers small, hermaphrodite; perianth segments and stamens 6, free or essentially so; ovary superior. 19. ASPARAGACEAE

Leaf blades expanded (sometimes nearly or quite as broad as long), reticulate-veined, sometimes deeply divided, the petiole obvious.

Ovary superior; flowers mostly unisexual and in axillary umbels; fruit a berry; climbing shrubs, the stems and branches often prickly, the petioles sometimes tendrillous. 20. SMILACACEAE

Ovary inferior; fruit a capsule or berry.

Flowers unisexual, small; ovary usually 3-locular with 2 ovules in each locule; seeds often winged; climbing vines (our species) usually with simple leaf blades. 21. DIOSCOREACEAE

Flowers hermaphrodite; ovary 1-locular with numerous ovules on parietal placentas; seeds longitudinally ridged; terrestrial plants with radical and (in our species) deeply lobed leaf blades.

22. TACCACEAE

Flowers slightly zygomorphic (at least in having 1 perianth segment slightly different from the others or one stamen longer than the others), hermaphrodite; aquatic herbs with erect or floating stems; inflorescence subtended by 1 or 2 spathe-like leaf sheaths; perianth corolline, persistent; stamens (in our genera) 6; ovary superior. 23. PONTEDERIACEAE

FAMILY 14. LILIACEAE

LILIACEAE Juss. Gen. Pl. 48, as *Lilia*. 1789.

Mostly perennial herbs, usually with rhizomes, corms, or bulbs, the stem erect or climbing, leafy or scapose; inflorescence commonly racemose but sometimes cymose; flowers hermaphrodite or rarely unisexual, usually actinomorphic, sometimes large and showy, usually 3-merous, hypogynous; perianth often corollalike, the segments mostly 6 in 2 distinct but very similar series, imbricate or those of the outer series valvate; stamens usually 6 (rarely 3 or up to 12), opposite the perianth segments, the anthers 2-locular, usually introrse and opening by longitudinal slits; ovary superior (rarely semi-inferior), usually 3-locular and with axile placentas, rarely 1-locular and with parietal placentas; style entire or divided; ovules usually numerous and 2-seriate in each locule, anatropous; fruit usually a loculicidal or septicidal capsule, rarely a fleshy berry; seeds with copious endosperm and a straight or curved embryo.

DISTRIBUTION: Worldwide, but most abundant in temperate and subtropical areas. The limits of the family are variously interpreted, but even if narrowly construed it contains at least 200 genera and perhaps 3,000 or more species. In Fiji only four genera of Liliaceae (as the family is delimited by Takhtajan) are represented, two of them by indigenous species and two by well-known cultivated plants.

USEFUL TREATMENT OF FAMILY: Hutchinson, J. Liliaceae. Fam. Fl. Pl. ed. 3. 732-757. 1973.

KEY TO GENERA

- Plants climbing by short, coiled tendrils terminating the upper leaves; flowers solitary, large, the perianth bright-colored, yellow and red, the style sharply deflected at base; fruit a loculicidal capsule with many seeds; cultivated only.1. *Gloriosa*
- Plants terrestrial or epiphytic but not climbing, the leaves without cirrhose tips.
- Fruit a loculicidal capsule; erect, tufted herbs, the leaves mostly crowded on the stem base; flowers large, hermaphrodite, in a paniculiform double bostryx; cultivated only.2. *Hemerocallis*
- Fruit a berry; flowers comparatively small; indigenous.
- Leaves in a dense cluster from base of stem; epiphytic (or infrequently terrestrial) herbs; inflorescence stiffly paniculate, with simply spicate branches; flowers dimorphic, the ♂ much larger than the ♀, the perianth segments white to greenish.3. *Collospermum*
- Leaves crowded on stem base and also more or less distichous along stem; terrestrial herbs; inflorescence a lax panicle with racemiform or corymbiform branches; flowers hermaphrodite, the perianth segments bluish.4. *Dianella*

1. *GLORIOSA* L. Sp. Pl. 305. 1753; Krause in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. 15a: 266. 1930.

Scandent herbs, the rootstock a horizontal rhizome, the stem leafy, the leaves spirally arranged or subopposite, the upper ones with cirrhose tips; flowers solitary, large, borne on long, spreading pedicels, actinomorphic, hermaphrodite; perianth segments 6, free, lanceolate, keeled within at base, long-persistent; stamens 6, hypogynous, the anthers extrorse, medifixed and versatile, opening by longitudinal slits; ovary superior, 3-celled, the carpels cohering only by their inner margins, the ovules numerous, the style deflected at base and projecting from the flower more or less horizontally; fruit a loculicidal capsule with many seeds.

TYPE SPECIES: *Gloriosa superba* L., the only original species.

DISTRIBUTION: About five species native in tropical Africa and Asia, some of them now widely cultivated.

1. *Gloriosa superba* L. Sp. Pl. 305. 1753; Yuncker in Bishop Mus. Bull. 178: 33. 1943; J. W. Parham, Pl. Fiji Isl. 263. 1964, ed. 2. 357. 1972; Sykes in New Zealand Dept. Sci. Indust. Res. Bull. 200: 255. 1970.

This showy ornamental has been recorded in our area only from Fiji and Niue; it is a scandent plant, climbing by leafy tendrils. The perianth segments, which are accrescent during anthesis and become reflexed, are striking in color, yellow proximally and at margins and dark red in the median portion. In Fiji it is sparingly grown near sea level.

TYPIFICATION: Linnaeus's several references indicate that the species was first known from India and Ceylon.

DISTRIBUTION: Southeastern Asia and parts of Malesia, but now widely cultivated. Although only one Fijian collection has been seen, it is not unusual in gardens, having been introduced in the 1880's.

LOCAL NAMES AND USES: *Climbing lily*; *gloriosa*. Parham (1972, cited above) states that recent experiments have been conducted as to the feasibility of growing the species commercially in Fiji, as the tuber is high in colchicine, which is used in the treatment of gout. It is a highly ornamental plant for garden use.

AVAILABLE COLLECTION: VITI LEVU: REWA: Suva Botanical Gardens, DA 12335.

2. *HEMEROCALLIS* L. Sp. Pl. 324. 1753; Krause in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. 15a: 296. 1930.

Erect, tufted herbs, the rootstock a short rhizome, the roots often thickened, the leaves mostly crowded on the stem base, linear, subdistichous; flowers in a paniculiform double bostryx, large, hermaphrodite; perianth segments connate proximally into a funnel-shaped tube, spreading distally; stamens inserted on perianth tube, shorter than perianth, the anthers dorsifixed, introrse; ovary 3-locular, the ovules numerous, axile, the style filiform, the stigma small, capitate; fruit a loculicidal capsule, the seeds black, few per cell.

LECTOTYPE SPECIES: *Hemerocallis lilio-asphodelus* L. (vide Britton & Brown, Ill. Fl. N. U. S. ed. 2. 1: 496. 1913), one of the two original species.

DISTRIBUTION: About 20 temperate Eurasian species, some of which are widely cultivated as ornamentals.

1. *Hemerocallis lilio-asphodelus* L. Sp. Pl. 324. 1753.

Hemerocallis flava L. Sp. Pl. ed. 2. 462. 1762; J. W. Parham, Pl. Fiji Isl. ed. 2. 357. 1972.

This coarse herb is sparingly grown near sea level for its attractive, bright yellow flowers.

TYPIFICATION AND NOMENCLATURE: In 1753 Linnaeus took *Hemerocallis lilio-asphodelus* as a collective species with two varieties, *flavus* and *fulvus*. In his second edition he used only the epithets *flava* and *fulva*, but the references ascribed to the original collective species are clearly listed with *H. flava*, which would therefore seem a direct synonym of *H. lilio-asphodelus*. *Hemerocallis* should be treated as feminine according to the ICBN, Rec. 75A (1), but since *Asphodelus* is a generic name the epithet *lilio-asphodelus* must retain its ending as a noun in apposition.

DISTRIBUTION: Indigenous in southern Europe and western Asia, but now widely cultivated. In Fiji it is more frequently seen in gardens than the single available collection would indicate.

LOCAL NAMES AND USE: *Day lily*; *yellow day lily*. Introduced as an ornamental.

AVAILABLE COLLECTION: VITI LEVU: REWA: Suva, Department of Agriculture compound, DA 12190.

3. *COLLOSPERMUM* Skottsb. in Kongl. Svenska Vetenskapsakad. Handl. 14 (2): 72. 1934.

Astelia sensu Seem. Fl. Vit. 313, p. p. 1868.

Dioecious epiphytic (or less often terrestrial) herbs, the rootstock a short rhizome, the leaves in a dense cluster from base of stem, linear; inflorescence paniculate, the branches simply spicate and densely floriferous; flowers dimorphic, the ♂ much larger than the ♀; perianth segments equal, basally connate into a campanulate tube, distally linear or linear-ovate, narrow, becoming reflexed; stamens 6, inserted on the perianth, the anthers linear, sagittate, basifixed, introrse; ovary 3-locular, with placentas on the interior parts of the dissepiments, the ovules several in each locule; ♂ flowers with a small, undeveloped pistillode; ♀ flowers with small staminodia, the pistil ovoid, with a short style and 3 sessile stigmas; fruit a carnos berry, the seeds small, irregularly sulcate, enclosed by a gelatinous aril-like cup derived from mucilaginous tubes developed from the funicle.

TYPE SPECIES: In describing the genus, Skottsberg proposed five new binomials, all formerly described in *Astelia*, without designating a type species. I have not ascertained that any subsequent author has proposed a lectotype species.

DISTRIBUTION: A genus of five species, three in New Zealand, one in Fiji, and one in Samoa, all endemic to their areas.

USEFUL TREATMENT OF GENUS: Skottsberg, C. Studies in the genus *Astelia* Banks et Solander. Kongl. Svenska Vetenskapsakad. Handl. 14 (2): 1-106. 1934.

In his scholarly work of 1934 Skottsberg presents a detailed study of *Astelia* and his new genus *Collospermum*. The latter is readily separated from *Astelia* by its simple inflorescence branches, dimorphic flowers, basifixed anthers, and by having its seeds enclosed in a mucilaginous cuplike organ derived from hairs arising from the funicle.

1. *Collospermum montanum* (Seem.) Skottsbg. in Kongl. Svenska Vetenskapsakad. Handl. 14 (2): 73. fig. 211-219; pl. 24, fig. 1. 1934; J.W. Parham, Pl. Fiji Isl. 263. fig. 92. 1964, ed. 2. 357. 1972. FIGURE 26.

Astelia montana Seem. in Bonplandia 9: 260, nom. nud. 1861, Viti, 443, nom. nud. 1862, Fl. Vit. 313. t. 95. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 319. 1892.

The endemic Fijian *Collospermum* may be found at elevations of 250-1,323 m., more frequently at the higher elevations, growing as an epiphyte (or less commonly terrestrial) in dense forest and in the dense thickets and forest of crests and ridges, where it is often locally abundant. This striking species bears its inflorescence in the center of a crowded rosette of basal leaves, with whitish green bracts subtending the spiciform branches. The perianth segments are translucent and white, cream-white, or greenish white; the anthers are cream-white, with greenish white filaments; and the pistil is pale green or pale yellow, with white stigmas. Young fruits are green but become darker, with opaque, black seeds. Flowering specimens have been collected from May to November and fruiting specimens from August to December.

TIPIFICATION: The holotype is *Seemann 641* (κ, 2 sheets, one with foliage and one with an inflorescence from the same plant), collected Sept. 6, 1860, at the summit of Mt. Mbukey Levu, Kandavu (alt. 838 m.). The second sheet at κ also bears a partial leaf marked "Vuna June 1860", presumably a fragment from a Taveuni collection that was added to the sheet. There is a specimen at BM without locality, but possibly it is an isotype. Seemann's account of his ascent of Mt. Mbukey Levu and the discovery of *Astelia montana* (Viti, 212-216. 1862) is a fascinating one.

DISTRIBUTION: Endemic to Fiji and thus far known from five of the high islands; because of the interest of this species I cite all the collections I have seen below (except the type).

LOCAL NAMES: Considering that it is not an "everyday" plant in Fiji, this striking *Collospermum* is known by a surprising number of names: *misi*, *misimisi*, *mbevu*,

mbeneveikau, *sei*, *malatava ni veikau*, and *vatakata* having been recorded. It can really have no practical use, unless one considers the collected water in its leaf bases suitable for making tea, as Seemann did.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Mt. Nanggaranambuluta, east of Nandarivatu, *Gillespie* 3949, *DA* 10381; ridge between Mt. Nanggaranambuluta and Mt. Namama, *Smith* 4963; summit and adjacent ridge of Mt. Tomanivi, *Smith* 5156, *DA* 3203, 12712 (*Melville et al.* 7101), 13081, *O.* & *I.* *Degener* 31995. NANDRONGA & NAVOSA: "Mountain forests of Navosa", *Horne* 1028. NAMOSI: Summit of Mt. Naitarandamu, *Gillespie* 3374; hills north of Wainavindrau Creek, between Korombasambasanga Range and Mt. Naitarandamu, *Smith* 8505; vicinity of Wainimakutu, *Gillespie* 3121; track to Mt. Nambui, Korombasambasanga Range, *DA* 14558. NAITASIRE: Matanatavo, head of Wainisavulevu Creek, Wainimala Valley, *St. John* 18312. KANDAVU: Mt. Mbuke Levu, *Smith* 262; without further locality, *DA* 14945. OVALAU: Summit of Mt. Ndelaiovalau and adjacent ridge, *Smith* 7618; without further locality, *Horne* 74. VANUA LEVU: THAKAUNDROVE: Mt. Uluingala, Natewa Peninsula, *Smith* 1978. TAVEUNI: Hills east of Somosomo, west of old crater occupied by small swamp and lake, *Smith* 8360.

4. *DIANELLA* Lam. ex Juss. Gen. Pl. 41. 1789.

Herbs with a subterraneous rhizome, the leaves linear, crowded on stem base or more or less distichous along stem; flowers in lax panicles with racemiform or corymbiform branches, hermaphrodite, actinomorphic, the pedicels articulate with perianth; perianth segments 6, equal and similar, spreading or reflexed, persistent until maturity of fruits; stamens 6, inserted on receptacle or on perianth, the filaments thickened near middle, the anthers 2-locular, opening by terminal pores, the connective swollen at base; ovary superior, 3-locular, with numerous ovules, the style filiform, the stigma small; fruit a berry, with 2-many seeds.

TYPE SPECIES: *Dianella ensata* (Thunb.) R.J. Henderson (*Dracaena ensata* Thunb.).

DISTRIBUTION: Mascarene Islands and tropical Asia to Australia, New Zealand, and the Pacific Islands; the genus probably contains about 30 species. One species occurs indigenously in Fiji.

USEFUL TREATMENTS OF GENUS: Skottsberg, C. *Dianella* Lam. Occas. Pap. Bishop Mus. 13: 234-240, 242. 1937. Schlitter, J. Monographie der Liliaceengattung *Dianella* Lam. Mitt. Bot. Mus. Univ. Zürich 163: 1-283. 1940. Henderson, R.J.F. Typification of *Dianella* Lam. ex Juss. (Liliaceae). Taxon 26: 131-137. 1977.

The only comprehensive revision of *Dianella*, that of Schlitter, is difficult to use and leaves many questions unanswered. The correct first publication and typification of the genus are extremely complicated matters; it would appear that the usual attribution of the generic name to Lamarck (Encycl. Méth. Bot. 2: 276. 1786) and its typification by *D. nemorosa* Lam. are questionable. The solution proposed recently by Henderson is here accepted.

1. *Dianella intermedia* Endl. Prodr. Fl. Norfolk. 28. 1833; Seem. Fl. Vit. 312. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 320. 1892; Gibbs in J. Linn. Soc. Bot. 39: 178. 1909; Skottsb. in Occas. Pap. Bishop Mus. 13: 234. 1937; Schlitter in Mitt. Bot. Mus. Univ. Zürich 163: 247. t. 9. 1940; Yuncker in Bishop Mus. Bull. 220: 79. 1959.

FIGURE 47.

Dianella ensifolia sensu Seem. in Bonplandia 9: 260. 1861, Viti, 443. 1862; Guillaumin in J. Arnold Arb. 13: 112. 1932; Yuncker in Bishop Mus. Bull. 220: 78. 1959; J.W. Parham, Pl. Fiji Isl. ed. 2. 357. 1972; non DC. in Redouté (1802).

Dianella nemorosa sensu Gibbs in J. Linn. Soc. Bot. 39: 178. 1909; J.W. Parham, Pl. Fiji Isl. 263. 1964; non Lam. nom. inval. (1786) et illeg. (1792).

Dianella caerulea sensu Krause in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. 15a: 295, p. p. 1930; non Sims (1801).

Dianella intermedia var. *norfolkensis* F. Br. in Occas. Pap. Bishop Mus. 9 (4): 11. 1930; J.W. Parham, Pl. Fiji Isl. 263. 1964, ed. 2. 357. 1972.

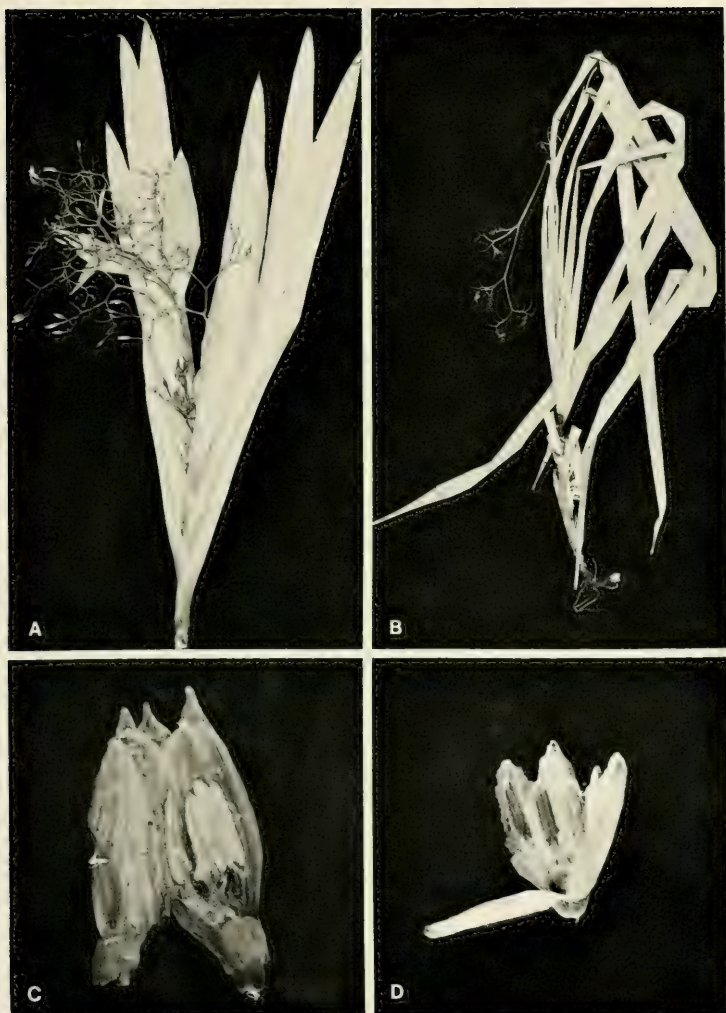


FIGURE 47. *Dianella intermedia*: A, flowering branch from dense mossy forest at summit of Mt. Tomani, $\times 1/4$; B, plant from thickets on limestone formation near sea level, Fulanga, $\times 1/4$; C, opened flower bud near anthesis, showing anthers appressed to style, $\times 6$; D, flower near anthesis, with two stamens removed, $\times 4$; A & C from Smith 5146, B & D from Smith 1195.

Dianella occurs indigenously in Fiji from near sea level to the highest elevation, 1,323 m., in thickets, open places, dense forest, and high mossy forest, as well as on grass- and fern-covered hills and ridges. It is a coarse herb, often branching, in dense, terrestrial clumps 0.5–2 m. high. The flower buds are greenish, the perianth segments at first white but usually becoming bluish-tinged; the filaments are white and the anthers yellow or pale yellow; and the fruits, at first green to purplish blue or brownish, become black at maturity. Flowers and fruits have been collected throughout the year.

TYPEIFICATION AND NOMENCLATURE: The holotype is a specimen collected by Ferdinand Bauer on Norfolk Island (perhaps at w); a drawing (*t.* 178, ined.) is at BM. *Dianella ensifolia* (L.) DC. (1802) is, according to Henderson (1977, cited above) a misapplied name which does not belong in the genus; it is based on *Dracaena ensifolia* L. *Dianella nemorosa* Lam., an illegitimate name, is at any rate lectotyped by Henderson by a Commerson collection from Mauritius and does not occur in the Pacific. *Dianella caerulea* enters our synonymy only because Krause in 1930 indicated its range as extending to Fiji; Schlitter (1940: 267) considers it limited to eastern Australia and Tasmania and perhaps Lord Howe Island. *Dianella intermedia* var. *norfolkensis* is based by Brown on two "reference types," *F. Brown 162* (BISH) from New Zealand and *Bryan 534* (BISH) from Fiji; as no specimens from Norfolk Island were cited by Brown, his choice of the varietal epithet is inexplicable.

Another name that enters into this confusing situation is *Anthericum adenanthera* Forst. f. *Fl. Ins. Austr. Prodr.* 24. 1786, based on material from New Caledonia. Skottsberg (in *Occas. Pap. Bishop Mus.* 13: 236. 1937) discusses the difficulties surrounding this name, for which a combination in *Dianella* has not been proposed, but it may indeed provide the oldest valid epithet for the present species. The entire complex requires more careful nomenclatural consideration than provided by Schlitter.

DISTRIBUTION: Material at K from Norfolk Island suggests that Schlitter is correct in considering *Dianella intermedia* to extend from New Zealand, Norfolk Island, New Caledonia, and the New Hebrides eastward into the Pacific. The Fijian collections, of which I have examined about 30, are variable and may eventually be found to represent more than one taxon. Variability is found in leaf width, color and size of perianth segments, and seed shape and size. Nevertheless, until the genus is better understood it seems unwise to suggest infraspecific taxa, as F. Brown has done for some of the southeastern Polynesian forms (cf. Skottsberg, 1937, cited above).

LOCAL NAME: *Varavara* has been recorded by Bryan for his Lau specimens, but this name usually refers to various terrestrial orchids.

REPRESENTATIVE COLLECTIONS: MAMANUTHAS: NGGALITO Island, Malolo Group, *O. & I. Degener* 32250; Mt. Evans Range, *Greenwood* 437, *DA* 14532; upper slopes of Mt. Koromba, *Smith* 4703; vicinity of Nandarivatu, *Gibbs* 573, 574, *Reay* 33; Sovutawambu, *Degener* 14588; summit and slopes of Mt. Tomanivi, *Smith* 5146, *DA* 14650, *Webster & Hildreth* 14186. "KANDAVU and MOTURIKI": *Seemann* 639. VANUA LEVU: MATHUATA: Summit ridge of Mt. Numbuiloa, east of Lambasa, *Smith* 6506. LAKEMBA: *Tohill*, July, 1927; high central ridges and peaks, *Bryan* 534. NAMUKA-I-LAU: *Bryan* 473. FULANGA: On limestone formation, *Smith* 1195.

The foliage variations of *Dianella intermedia* in Fiji appear to be due to exposure, having no correlation with elevation. Specimens from shady, forested areas have the leaves as much as 33 mm. broad, with flat margins and nerves conspicuously raised on both surfaces. Specimens from dry or exposed areas have the leaves often 10–14 (rarely only 3) mm. broad, with recurved or even revolute margins and sometimes subimmersed nerves.

FAMILY 15. ALLIACEAE

ALLIACEAE J. Agardh, Theor. Syst. Pl. 32. 1858.

Bulbous or rhizomatous herbs; differing from Liliaceae in having a scapose, umbellate inflorescence subtended by spathaceous, somewhat membranaceous bracts, from Amaryllidaceae in having its ovary superior.

DISTRIBUTION: A cosmopolitan family (lacking in Australia) of about 30 genera and 600 species.

Although the Alliaceae are a group of plants that have been referred to both the Liliaceae and the Amaryllidaceae, they are now frequently accepted as forming a distinct family. Hutchinson retains the group in the Amaryllidaceae, where it is composed of the first three tribes of the family (Fam. Fl. Pl. ed. 3. 791-794. 1973). At the other extreme, H. P. Traub (in Taxon 24: 458. 1975) suggests raising the Alliaceae to the rank of order, on the basis of their distinct chemical and morphological characteristics.

1. *ALLIUM* L. Sp. Pl. 294. 1753; Krause in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. 15a: 319. 1930.

Mostly bulbous, sometimes tuberous herbs, the leaves radical, linear or fistular; flowers in pedunculate umbels, the peduncle with apical, membranaceous bracts; perianth segments 6, free or shortly connate; stamens 6, inserted on base of perianth, the anthers dimixed; ovary superior, 3-celled, the style filiform; capsule loculicidally 3-valved.

LECTOTYPE SPECIES: *Allium sativum* L. (vide Britton & Brown, Ill. Fl. N. U. S. ed. 2. 1: 497. 1913), one of the 30 species originally assigned to the genus by Linnaeus.

DISTRIBUTION: A Northern Hemisphere genus of about 450 species.

Although species of *Allium* do not grow well in the Pacific area, two species have been recorded as in cultivation in Fiji. Additionally, the leek, *A. porrum* L., is probably grown in Fiji; it is noted in Tonga by Yuncker (in Bishop Mus. Bull. 220: 80. 1959).

KEY TO SPECIES

- Bulbs broadly ovoid, usually solitary, rounded distally; peduncle conspicuously ventricose below middle; perianth segments white or greenish, the stamens at length far exserted. 1. *A. cepa*
 Bulbs often angular, usually in a group and appressed to one another, subacute distally; peduncle not or inconspicuously ventricose below middle; perianth segments pink, purple, or white, the stamens usually not exserted or only rarely so. 2. *A. ascalonicum*

1. *Allium cepa* L. Sp. Pl. 300. 1753; Yuncker in Bishop Mus. Bull. 178: 32. 1943, in op. cit. 220: 80. 1959; Sykes in New Zealand Dept. Sci. Indust. Res. Bull. 200: 254. 1970; J. W. Parham, Pl. Fiji Isl. ed. 2. 357. 1972.

The introduced onion does not thrive in Fiji but is cultivated on a small scale.

TIPIFICATION: Linnaeus gives several prior references, but I have not noted a lectotypification.

DISTRIBUTION: Eurasia; cultivated elsewhere; noted from Tonga and Niue.

LOCAL NAMES AND USE: *Onion*, *varasa*, *piaz*; cultivated for its edible bulb.

Apparently no herbarium specimens document the occurrence of the onion in Fiji, but it can be seen in many small gardens.

2. *Allium ascalonicum* L. Fl. Palaestina, 17. 1756, Amoen. Acad. 4: 454. 1759; Seem. Viti, 443. 1862.

Allium schoenoprasum sensu Seem. in Bonplandia 9: 260. 1861; non L.

The introduced shallot is recorded in Fiji only by Seemann.

TYPEIFICATION: No specimen was mentioned in the original publication, but the description is valid and adequate.

DISTRIBUTION: Presumably a plant originating in the Levant, sometimes considered a variety of the preceding species.

LOCAL NAME AND USE: *Varasa*; a plant with edible bulbs.

Although Seemann listed his no. 637 as representing the shallot, neither this nor any other Fijian specimen seems available for documentation; however, it is probable that his identification was correct and that the shallot may still be found in small Fijian gardens. Collections are available from southeastern Polynesia.

FAMILY 16. AGAVACEAE

AGAVACEAE Endl. Ench. Bot. 105, as *Agaveae*. 1841.

Robust, rhizomatous, often woody or arborescent plants, the stem short or well developed, sometimes lacking; leaves often crowded at or near base of stem, narrow, often thick or fleshy, entire, often with spiny teeth on margin; flowers hermaphrodite (in all genera in Fiji), polygamous, or unisexual, actinomorphic or somewhat zygomorphic, in terminal spikes, racemes, or panicles, sometimes arranged in a large thyse, the branches subtended by bracts; perianth tube short to long, the segments unequal or subequal; stamens 6, inserted at base of perianth segments or on perianth tube, the filaments filiform or thickened, free, the anthers introrse, linear, usually dorsifixed, 2-locular, opening by longitudinal slits; ovary superior or inferior, 3-locular, with axile placentas, the style slender, the ovules numerous to solitary in each locule, often superposed in 1 or 2 series, anatropous; fruit a loculicidal capsule or berry; seeds numerous or solitary, compressed, with fleshy endosperm and small embryo.

DISTRIBUTION: About 20 genera and 600–700 species in the tropics and subtropics of both hemispheres, often abundant in dry regions. Five genera occur in Fiji but none are indigenous, although *Cordyline* is so firmly naturalized as to appear native.

USEFUL DISCUSSION OF FAMILY: Tomlinson, P. B., & M. H. Zimmermann. Vascular anatomy of monocotyledons with secondary growth—an introduction. *J. Arnold Arb.* 50: 159–179. 1969.

KEY TO GENERA

Ovary superior.

Leaves borne on superterranean branchlets; flowers in large panicles.

Perianth segments connate or coherent only at base; ovules 4—many per ovary locule; probably an aboriginal introduction but now firmly naturalized and appearing indigenous. . . . 1. *Cordyline*

Perianth with a well-developed tube; ovules solitary in each ovary locule; cultivated only.

2. *Pleomele*

Leaves borne on a subterranean rhizome, erect, fibrous, transversely banded; flowers in simple or branched racemes; cultivated only. . . . 3. *Sansevieria*

Ovary inferior; plants with subterranean or short stems with densely crowded leaves and a large, terminal panicle; cultivated and sparingly naturalized.

Perianth segments proximally connate into a short tube; filaments surpassing the perianth segments, filiform, not much thickened in the middle. . . . 4. *Agave*

Perianth segments essentially separate; filaments shorter than the perianth segments, with a spongy thickening in the middle. . . . 5. *Furcraea*

1. *CORDYLINE* Commerson ex Juss. Gen. Pl. 41. 1789; Seem. Fl. Vit. 310. 1868; Baker in J. Linn. Soc. Bot. 14: 535. 1875; Krause in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. 15a: 356. 1930. Nom. cons.

Taetsia Medik. Theodora, 82. 1786. Nom. rejic.

Stem woody and often branched, the branchlets with annular leaf scars; leaves spirally crowded distally on branchlets, linear or lanceolate, the petiole basally broadened into a sheath; flowers in large, glabrous, pedunculate, freely branched panicles; perianth segments 6, connate or coherent at base, free and becoming reflexed distally, equal or the inner 3 slightly the longer; stamens 6, the anthers medifixed; ovary superior, 3-locular, the ovules 4—many per locule, the style filiform, the stigma capitate or 3-lobed; fruit globose or 3-lobed, fleshy, indehiscent or tardily dehiscent, the seeds black, nitid.

TYPE SPECIES: *Cordyline terminalis* (L.) Kunth (*Asparagus terminalis* L.). *Taetsia*, a prior but rejected generic name, is typified by *T. ferrea* (L.) Medik. (*Dracaena ferrea* L.).

DISTRIBUTION: A tropical and warm temperate genus of about 15 species.

1. *Cordyline terminalis* (L.) Kunth in Abh. Königl. Akad. Wiss. Berlin **1842**: 30. 1842; Seem. Fl. Vit. 311. 1868; Baker in J. Linn. Soc. Bot. **14**: 539. 1875; Drake, Ill. Fl. Ins. Mar. Pac. 319. 1892; Gibbs in J. Linn. Soc. Bot. **39**: 178. 1909; Christophersen in Bishop Mus. Bull. **128**: 48. 1935; Yuncker in op. cit. **178**: 33. 1943, in op. cit. **184**: 28. 1945, in op. cit. **220**: 79. 1959; J. W. Parham in Agr. J. Dept. Agr. Fiji **29**: 32. 1959, Pl. Fiji Isl. 270. 1964, ed. 2. 366. 1972; Sykes in New Zealand Dept. Sci. Indust. Res. Bull. **200**: 255. 1970; B. E. V. Parham in New Zealand Dept. Sci. Indust. Res. Inform. Ser. **85**: 126. 1972. FIGURE 48.

Convallaria fruticosa L. Herb. Amb. 16. 1754, Amoen. Acad. **4**: 126. 1759.

Asparagus terminalis L. Sp. Pl. ed. 2. 450. 1762.

Dracaena terminalis Lam. Encycl. Méth. Bot. **2**: 324. 1786; B. E. V. Parham in Agr. J. Dept. Agr. Fiji **13**: 42. 1942.

Cordyline jacquini Kunth in Abh. Königl. Akad. Wiss. Berlin **1842**: 30. 1842.

Cordyline sp. Seem. in Bonplandia **9**: 260. 1861, Viti, **443**. 1862.

Cordyline jacquinii Kunth ex Seem. Fl. Vit. 311. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 319. 1892.

Cordyline sepiaria Seem. Fl. Vit. 311. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 319. 1892.

Dracaena sepiaria Seem. Fl. Vit. *t.* 94. 1868.

Cordyline terminalis var. *sepiaria* Baker in J. Linn. Soc. Bot. **14**: 540. 1875; Engl. in Bot. Jahrb. **7**: 448. 1886.

Taetsia fruticosa Merr. Interpret. Rumph. Herb. Amb. 137. 1917; A. C. Sm. in Sci. Monthly **73**: 14. fig. 1951.

Cordyline fruticosa A. Chev. Cat. Pl. Jard. Bot. Saigon, 66. 1919; non Goepp. (1855).

Cordyline terminalis gives every appearance of being indigenous in Fiji, occurring at elevations from near sea level to 1,100 m., often being abundant in various types of forest (dry, dense, edges), on forested ridges, in thickets, and sometimes near beaches; it is also often seen in cultivation. The plant is an erect shrub or tree, often simple-stemmed but frequently freely branched, 1–5 m. high. The inflorescence is up to 1 m. long, with rich pink bracts. The perianth segments vary in color but are often rich pink, sometimes white mottled with pink, or white near base and pink distally; the filaments are white, often with bright yellow anthers; the style is pink-tinged distally; and the fruit at maturity is deep red. Flowers and fruits are seen throughout the year.

TYPOIFICATION AND NOMENCLATURE: The oldest name referable to this taxon is *Convallaria fruticosa* L., based entirely on *Terminalis* Rumph. Herb. Amb. **4**: 79. *t.* 34. 1743. The Rumphian illustration shows two forms, one with greenish leaves and one with reddish or purplish leaves; in proposing the combination *Taetsia fruticosa* in 1917, Merrill considered these both to represent the common species. The transfer of the epithet *fruticosa* to *Cordyline*, now a conserved name, was made only in 1919 by Chevalier. However, Chevalier's combination is a later homonym of *C. fruticosa* Goepp. (in Nova Acta Acad. Leop.-Carol. **25**: 53. 1855), based on "*Dracaena fruti-*



FIGURE 48. *Cordyline terminalis* in the upland forest of Viti Levu, showing the tip of a branch, leaves, and the terminal inflorescence, from *Smith 4038*.

cosa Ht. Berol.", apparently ultimately derived from *Sansevieria* (sic) *fruticosa* Bl. (Enum. Pl. Javae, 11. 1827), which in turn was based on *Terminalis augustifolia* Rumph. and is referable to *Pleomele angustifolia* (Roxb.) N. E. Br.

Since the epithet *fruticosa* may not be used in *Cordyline*, the next oldest basionym is *Asparagus terminalis* L. According to Merrill (1917, cited above) this is based on an actual specimen, although *Terminalis* Rumph. is cited as a synonym.

Cordyline jacquini Kunth appears to be a renaming of *Dracaena terminalis* Jacq. (Collect. 2: 354. 1788), non Lam. (1786, cited above). *Cordyline sepiaria* (inadvertently labeled *Dracaena sepiaria* on his illustration) was described by Seemann as a new species. Seemann typified his new species by *Seemann 634* (K HOLOTYPE; ISOTYPE at BM), from "Viti Levu and Taveuni." Seemann believed *C. sepiaria* to be indigenous and to differ from the introduced *C. terminalis* in several minor respects including its non-tuberous roots. Seemann recognized three species of *Cordyline* in Fiji: his "wild" form (*C. sepiaria*), with linear-lanceolate green leaves; the introduced *C. terminalis*, with oblong-lanceolate leaves and an edible, tuberous root; and the introduced red-leaved *C. jacquini*.

DISTRIBUTION: Baker, in his treatment of 1875 (cited above) suggests that *Cordyline terminalis* is indigenous in the Himalayas, southeastern Asia, Malesia, and northern Australia. The precise eastern line beyond which it is not indigenous may never be known, since in many Pacific archipelagoes it is so thoroughly naturalized as to appear native. Almost certainly it was an aboriginal introduction into Fiji and the groups farther east, since it is so useful and ornamental that the earliest occupants would have brought it with them. It is now cultivated practically everywhere in the moist tropics and subtropics. I have examined about 60 Fijian collections, but the species is more abundant than this would suggest, both "wild" and cultivated.

LOCAL NAMES AND USES: *Nggai* is the most widely used Fijian name, but also recorded are: *nggainggai*, *vasili*, *vasili kau*, *vasili ni veikau*, *vasili Tonga*, *masawe*, *vakota*, *nakota*, *kokota*, *ngolo*, and *ti* (the usual Polynesian name). The red-leaved form is often called *ti kula* or *vasili ndamu*. It is a plant of many uses, in addition to being an ornamental often used in hedges. As elsewhere in the Pacific, the leaves are used for wrapping food before baking it and are also made into skirts for ceremonial wear. The tuberous root may weigh 10-14 pounds (Seemann) and is edible after being baked on heated stones. In modern times it is still used to sweeten puddings and other foods. Apparently the Fijians never extracted an alcohol from it, as some Polynesians do. It is further reported to have unspecified medicinal uses.

REPRESENTATIVE COLLECTIONS: YASAWAS: WAYA: Along Wailevu Creek, *St. John 18075*. MAMANUTHAS: NGGALITO Island, Malolo Group, *O. & I. Degener 32253*. VITI LEVU: MBA: Natualevu, Mt. Evans Range, *DA 14193*; slopes of Mt. Nairoa, eastern flank of Mt. Evans Range, *Smith 4038*; vicinity of Nandarivatu, *Gillespie 4313*; Navai, *Gibbs 781*. NANDRONGA & NAVOSA: Northern portion of Rairaimatuku Plateau, *Smith 5471*; near Kalavo, *H. B. R. Parham 228*. SERUA: Between Wainigere and Waisese Creeks, *Smith 9663*; Ndeumba, *DA 9217 (McKee 2781)*. NAMOSI: Nambukavesi Creek, *DA 11591*. RA: Vicinity of Rewasa, *Degener 15400*. NAITASIRI: Viria, *Parks 20447*; Tholo-i-suva, *DA 11967*. TALEVU: Hills east of Wainimbuka River, near Ndakuivuna, *Smith 7047*. REWA: Slopes of Mt. Korombamba, *Gillespie 2296*. MBENGA: *Weiner 186*. KANDAVU: Mt. Mbuke Levu, *Smith 222*. OVALAU: *Bryan 607*. KORO: *Tothill 897*. NAIRAI: *Tothill 898*. VANUA LEVU: MATHUATA: In mountains, *Greenwood 668*; Wainikoro River, *Greenwood 690*. THAKAUNDROVE: Vicinity of Savusavu, *Bierhorst F216*. TAVEUNI: Vicinity of Wairiki, *Gillespie 4750*. MOALA: *Milne 117*. MATUKU: *Tothill 899*. TOTOA: *Bryan 361*. VANUA MBALAVU: Slopes of Korolevu, near Lomaloma, *Garnock-Jones 1019*. LAKEMBA: Near Nukunuku Village, *Garnock-Jones 816*. KAMBARA: On limestone formation, *Smith 1273*. FIJI without further locality, *Seemann 635, 636*.

Cordyline terminalis is an extremely plastic species, with innumerable cultivars. Baker (1875, cited above) accounted for eight varieties, but many others have been recognized, most of them no more than cultivars. The species was doubtless introduced into Fiji repeatedly, and any infraspecific classification seems fruitless.

2. *Pleomele* Salisb. Prodr. Stirp. 245. 1796; N. E. Br. in Kew Bull. **1914**: 274. 1914.

Stem (in our species) woody and copiously branched, the branchlets with distinct leaf scars; leaves crowded distally on branchlets, oblong to lanceolate; flowers in terminal, glabrous panicles and congested in heads (in our species); perianth with a well-developed tube, the segments 6, subequal, narrow; stamens 6, inserted at top of perianth tube, the filaments filiform, the anthers medifixed; ovary superior, sessile, 3-locular, the ovules solitary in each locule, the style filiform, subentire; fruit a globose berry, 1-3-seeded.

LECTOTYPE SPECIES: *Pleomele fragrans* (L.) Salisb. (*Aletris fragrans* L.); cf. N. E. Br. in Kew Bull. **1914**: 274. 1914. This is one of the two species originally placed in *Pleomele* by Salisbury; the other, *P. aloifolia*, is placed in *Sansevieria* by Brown.

DISTRIBUTION: A genus of 100 or more species in tropical regions of the Old World, eastward into Malesia; some species are widely cultivated, including the one recorded from Fiji.

USEFUL TREATMENT OF GENUS: Brown, N. E. Notes on the genera *Cordyline*, *Dracaena*, *Pleomele*, *Sansevieria* and *Tactisia*. Kew Bull. **1914**: 273-279. 1914.

Pleomele is often combined with *Dracaena* Vand. ex L., but Brown (cited above) suggests reasons for keeping the genera separate. *Dracaena* has its perianth segments separate nearly to base, not forming an evident tube, and its flowers occur in clusters at the nodes of the panicle branches; the filaments are thickened at the middle. *Pleomele* has its perianth segments united proximally into a distinct tube at least one-third as long as the lobes, and its flowers are solitary or in pairs or clusters in a spikelike raceme or in a dense spike or head on the panicle; the filaments are filiform.

1. *Pleomele fragrans* (L.) Salisb. Prodr. Stirp. 245. 1796; N. E. Br. in Kew Bull. **1914**: 274, 278. 1914; J. W. Parham, Pl. Fiji Isl. ed. 2. 367. 1972.

Aletris fragrans L. Sp. Pl. ed. 2. 456. 1762.

Dracaena fragrans Ker-Gawler in Bot. Mag. **27**: t. 1081. 1808; Baker in J. Linn. Soc. Bot. **14**: 529. 1875.

In Fiji this striking ornamental is grown from near sea level to 250 m. It is a few-branched tree 3-5 m. high, with leaves and inflorescences crowded toward apices of branchlets. The inflorescence, up to 80 cm. long, has perianth segments pale purple without and white within, white filaments with pale yellow anthers, and white styles; the fruit is an orange berry. Flowers have been noted in June, November, and December.

TYPIFICATION: Linnaeus based *Aletris fragrans* on J. Commelijn, Horti Med. Amstelod. **1**: 93. t. 49. 1697, **2**: 7. t. 4. 1701.

DISTRIBUTION: A native of west tropical Africa, this species is now widely cultivated. Only two Fijian collections have been seen, but the plant is moderately common in cultivation in Fiji.

USE: Introduced and grown for its ornamental value.

AVAILABLE COLLECTIONS: VITI LEVU: SERUA: Ngaloa, *Smith 9442*. NAITASIRI: Toninaiwau, Tholo-isuva, *DA 16489*.

An interesting account of this species has been published by M. H. Zimmermann and P. B. Tomlinson (The vascular system in the axis of *Dracaena fragrans* (Agavaceae). 1. Distribution and development of primary strands. *J. Arnold Arb.* **50**: 370–383. fig. 1–13. 1969).

3. *SANSEVIERIA* Thunb. Prodr. Pl. Cap. 65. 1794; N. E. Br. in Kew Bull. **1915**: 188. 1915; Krause in Engl. & Prantl, Nat. Pflanzenz. ed. 2. **15a**: 360. 1930. Nom. cons.

Stemless herbs, the leaves borne on a subterraneous, sympodial rhizome, erect, fibrous, in our species broader than thick, subcoriaceous; flowers in terminal, simple or branched racemes; perianth segments 6, proximally connate into a tube, distally narrowly linear and becoming recurved; stamens 6, inserted at top of perianth tube, the filaments filiform, the anthers medifixed; ovary superior, sessile, 3-locular, the ovules 3 in each locule, the style filiform, the stigma entire; fruit a berry with 1–3 seeds.

TYPE SPECIES: *Sansevieria thyrsiflora* Thunb. nom. illeg. (*Aloe hyacinthoides* var. *guineensis* L.) (*Aloe guineensis* Jacq.) = *S. guineensis* (L.) Willd. Typ. cons.

DISTRIBUTION: About 60 species in tropical and southern Africa, Madagascar, and Arabia, with a few species as far east as Ceylon, India, Burma, and perhaps China. One species is cultivated in Fiji.

USEFUL TREATMENT OF GENUS: Brown, N. E. *Sansevieria*. A monograph of all the known species. Kew Bull. **1915**: 185–261. 1915.

1. *Sansevieria trifasciata* Hort. ex Prain, Bengal Pl. 1054, as *Sanseviera t.* 1903; N. E. Br. in Kew Bull. **1915**: 239. 1915; Sykes in New Zealand Dept. Sci. Indust. Res. Bull. **200**: 217. 1970.

Sansevieria zeylanica sensu Yuncker in Bishop Mus. Bull. **178**: 33. 1943; non Willd.

This widely cultivated *Sansevieria* is seen near sea level in Fiji; it is a coarse herb with erect leaves to 1 m. long cross-banded with light and dark green. The fragrant flowers have greenish white perianth segments, and the fruit is a reddish orange berry.

TYPIFICATION: In his original publication Prain merely remarks: "Often cultivated, sometimes as an escape." Brown, in 1915, suggests that the species was typified by living plants cultivated at Kew.

DISTRIBUTION: A native of tropical Africa, *Sansevieria trifasciata* is now widely cultivated and sometimes naturalized. In our area it occurs in Niue and specimens have also been seen from many Polynesian archipelagoes. Only one Fijian specimen has been noted, but it is frequently cultivated in Suva and elsewhere.

LOCAL NAMES AND USES: *Bowstring hemp*; *mother-in-law's tongue*. In Fiji it is used only as an ornamental, but elsewhere fiber from the leaves is used for twine, mats, etc.

The two common varieties are grown in Fiji, distinguishable as follows:

Leaves transversely banded with light green and dark or blackish green stripes 1a. var. *trifasciata*
Leaves similar but also with longitudinal golden yellow stripes and margins 1b. var. *laurentii*

- 1a. *Sansevieria trifasciata* var. *trifasciata*; J. W. Parham, Pl. Fiji Isl. 270. 1964, ed. 2. 367. 1972.

AVAILABLE COLLECTION: VITI LEVU: REWA: Suva Botanical Gardens, DA 12170.

- 1b. *Sansevieria trifasciata* var. *laurentii* (De Willdem.) N. E. Br. in Kew Bull. **1915**: 240. 1915; J. W. Parham, Pl. Fiji Isl. 270. 1964, ed. 2. 367. 1972.

Sanseviera laurentii De Willdem. in Rev. Cult. Colon. **14**: 231. 1904.

TIPIFICATION: Described from specimens growing in Belgian gardens, but originally discovered near Stanleyville in the then Belgian Congo and introduced into cultivation by Emile Laurent.

The Fijian record is based on observations only.

4. AGAVE L. Sp. Pl. 323. 1753.

Robust herbs, the short stem increasing in thickness; leaves radical or crowded on the stem, fibrous, with an apical spine and often with marginal spines; flowers in large, terminal, pedunculate panicles, solitary along rachises of inflorescence; perianth segments 6, proximally connate into a short tube, subequal; stamens 6, inserted below top of perianth tube, at length exerted, the filaments filiform, the anthers linear, medifixed; ovary inferior, 3-locular, the ovules numerous and biseriate in each locule, the style filiform, the stigma thickened, 3-lobed; fruit a loculicidal capsule, the seeds numerous, flat, black.

LECTOTYPE SPECIES: *Agave americana* L. (vide Britton & Wilson, Sci. Surv. Porto Rico 5: 156. 1923), one of the four original species of Linnaeus.

DISTRIBUTION: About 300 species in America, from the southern United States to tropical South America. Two species occur in cultivation in Fiji, one of them sometimes becoming naturalized.

KEY TO SPECIES

- Leaves with margins thorny to apex and with a yellow strip; cultivated only.1. *A. americana*
 Leaves with a bluish tinge, the margins without spines or these very occasional and widely spaced; cultivated for its useful leaf fibers, and also naturalized.2. *A. sisalana*

1. *Agave americana* L. Sp. Pl. 323. 1753; Engelmann in Trans. Acad. Sci. St. Louis 3: 292. 1876; J. W. Parham in Agr. J. Dept. Agr. Fiji 29: 31. 1959, Pl. Fiji Isl. 270. 1964, ed. 2. 366. 1972.

In Fiji this species is cultivated from sea level to about 250 m.; it is a coarse herb with leaves about 1 m. long. Flowering has not been observed in Fiji.

TIPIFICATION: Several prior references are given by Linnaeus, and I am not aware of a lectotypification.

DISTRIBUTION: Tropical America, but also widely cultivated.

LOCAL NAMES AND USES: *Century plant*; moderately common in cultivation in Fiji as an ornamental (although documented by only one collection). In Mexico the species is extensively cultivated and is the source of the drink *pulque*.

AVAILABLE COLLECTION: VITI LEVU: NAITASIRE: Toninaiwau, Tholo-i-suva, DA 16753.

2. *Agave sisalana* Perrine in House Rep. Doc. 564: 8. 1838; Trel. in Mem. Nat. Acad. Sci. 11: 49. pl. 113-115. 1913; Greenwood in J. Arnold Arb. 25: 402. 1944, in op. cit. 30: 82. 1949; J. W. Parham in Dept. Agr. Fiji Bull. 35: 148. 1959, Pl. Fiji Isl. 270. 1964, ed. 2. 366. 1972.

Agave rigida var. *sisalana* Engelmann in Trans. Acad. Sci. St. Louis 3: 316. 1876.

In Fiji *Agave sisalana* is cultivated and is also naturalized on grass- and reed-covered hillsides from near sea level to 450 m. It is a coarse perennial herb with basal leaves to 2 m. long. The erect inflorescence may attain a height of 10 m.; the perianth segments are greenish to white or cream-colored. Bulbils are often produced in the axils of bracteoles on the pedicels after the flowers have fallen.

TIPIFICATION: No type was cited by Perrine, who indicated that the plant grows spontaneously throughout the state of Yucatán, Mexico.

DISTRIBUTION: Central America and Mexico, now widely cultivated for its fiber.

LOCAL NAMES AND USES: *Sisal hemp*; *ndali*; *natali*. The fibers of the leaves are used mainly in the manufacture of twines and cordage, and the species is said to provide over 65% of the world's trade in hard fibers. An extended discussion is provided by Pursglove (Trop. Crops, Monocot. 14-29, fig. 2. 1972).

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Vicinity of Tumbenasolo, valley of Namosi Creek, *Smith 4629*. NANDRONGA & NAVOSA: Singatoka Valley Road, *DA 16298*.

Agave sisalana is generally considered to be a cultigen or cultivar. Engelmann (1876, cited above) believed it to be a large, cultivated derivative of *A. rigida* Mill. Pursglove (1972, cited above) treats it as a naturally occurring pentaploid hybrid, while Burkill (Dict. Econ. Prod. Malay Penins. ed. 2. 70. 1966) thought it to be a selection by man from something like *A. fourcroyoides* Lem.

5. *FURCRAEA* Vent. in Bull. Sci. Soc. Philom. Paris **1**: 65. 1793.

Plants with a subterranean woody stem; leaves densely crowded, fibrous, the margins (in our species) copiously spiny at least toward base; flowers in large, terminal, pedunculate panicles, fascicled or solitary along rachises of inflorescence; perianth segments 6, essentially separate, subequal but the inner ones broader; stamens 6, inserted at base of perianth segments and shorter, the filaments with a spongy thickening in middle, subulate distally, the anthers medifixed; ovary inferior, 3-locular, the ovules numerous in each locule, the style thickened at base, filiform-subulate distally, the stigma small; fruit a loculicidal capsule, the seeds numerous, flat.

LECTOTYPE SPECIES: *Furcraea cubensis* (Jacq.) Vent. (*Agave cubensis* Jacq.); vide Britton, Fl. Bermuda, 80. 1918.

DISTRIBUTION: About 20 species in arid and semiarid regions of tropical America. One species is cultivated and sparingly naturalized in Fiji.

1. *Furcraea foetida* (L.) Haw. Syn. Pl. Succ. 73. 1812; Sykes in New Zealand Dept. Sci. Indust. Res. Bull. **200**: 217. 1970.

Agave foetida L. Sp. Pl. 323. 1753.

Furcraea gigantea Vent. in Bull. Sci. Soc. Philom. Paris **1**: 65, nom illeg. 1793; Yuncker in Bishop Mus. Bull. **178**: 35. 1943, in op. cit. **220**: 81. 1959; J.W. Parham, Pl. Fiji Isl. ed. 2. 366. 1972; B.E.V. Parham in New Zealand Dept. Sci. Indust. Res. Inform. Ser. **85**: 64. 1972.

Agave gigantea D. Dietr. Syn. Pl. **2**: 1192, nom. illeg. 1840.

Fourcroya cubensis sensu Christophersen in Bishop Mus. Bull. **128**: 50. 1935; non Vent.

In Fiji *Furcraea foetida* is cultivated and sparingly naturalized near sea level. It is a rosette herb with an inflorescence up to 12 m. high. The flowers have a heavy fragrance; the perianth segments are white or greenish white, and the ovary yellowish green. The flowers are usually followed by bulbils.

TYPIFICATION AND NOMENCLATURE: Linnaeus gives several prior references and indicates the habitat of the plant as Curaçao. Ventenat merely mentions "Habitat in Curassao", but since he listed *Agave foetida* as a synonym his name is illegitimate. Christophersen's reference to *F. cubensis* doubtless refers to *F. foetida*, known to be cultivated in Samoa, Tonga, and Niue as well as in Fiji.

DISTRIBUTION: A native of tropical South America, now widely cultivated for its fiber.

LOCAL NAMES AND USES: *Mauritius hemp*; it is often confused in Fiji with *sisal hemp*, and it has erroneously been called *cuban hemp* in Samoa. It was introduced in 1907 for commercial development, its fibers being used for ropes and cords. In Mauritius it is an important crop plant and is also used for boundary hedges. The

name *Mauritius hemp*, although geographically a misnomer, is firmly attached to this species.

AVAILABLE COLLECTIONS: VITI LEVU: NANDRONGA & NAVOSA: Singatoka Valley Road, DA 16037; near Thuvu Beach, DA 11420. REWA: Suva Botanical Gardens, DA, Jan. 6, 1949, June 13, 1949, Jan. 28, 1950. LAKEMBA: Yandrana Village, Garnock-Jones 945. NAMUKA-I-LAU: Near South Bay sand beach, Bryan 472. J. W. Parham (1972, cited above) mentions its occurrence on Vanua Levu, but I have found no voucher for this.

The fibers of *Mauritius hemp* are longer, finer, and whiter than those of sisal hemp, but are not as strong (Purseglove, Trop. Crops, Monocot. 30. 1972). These two species are frequently confused in Fiji, being similar in general appearance and in producing bulbils; the following key will serve to distinguish them even when sterile.

Leaves with bluish tinge, the margins without spines or these (in the variety grown in Fiji) very occasional and widely spaced; stamens longer than perianth, the filaments and style filiform. . . . *Agave sisalana*
 Leaves yellow-green, the basal parts of margins copiously spiny, the spines sometimes extending to apex, but apical portion sometimes lacking spines (spiny margins characteristic of the variety grown in Fiji but not universal in the species); stamens shorter than perianth, the filaments with a spongy thickening in middle, the style thickened at base. *Furcraea foetida*

FAMILY 17. AMARYLLIDACEAE

AMARYLLIDACEAE Jaume St. Hil. Expos. Fam. Nat. 1: 134, as *Amaryllideae*. 1805.

Herbs with a subterraneous bulb or tuber, rarely with a rhizome; leaves usually few, radical, linear, oblong, or rarely reniform-cordate, parallel-nerved or curvinerved; flowers ♀, usually showy and actinomorphic, less often zygomorphic, monochlamydeous, in pedunculate umbels with few (rarely 1)–many flowers, the umbels involucrate at base with 1–3 bracts, the peduncles leafless; perianth petaloid, the segments 6 in 2 series, free or connate, equal or unequal; stamens 6, rarely more, inserted in corolla tube (in all our genera) or at base of perianth segments, the filaments free or connate into a tube and forming a “false corona”, the anthers basifixed or medifixed, 2-locular, dehiscent introrsely and longitudinally; ovary inferior (in all our genera) or rarely half-inferior, 3-celled or rarely 1-celled, the ovules numerous to few per cell, anatropous, borne on axile or rarely parietal placentas, often biseriately superposed, the style slender, the stigma capitate or 3-lobed; fruit a dehiscent or indehiscent capsule or a berry, the seeds 1–many, angular-compressed or winged, with fleshy endosperm and a small, straight embryo.

DISTRIBUTION: A family of about 85 genera and 1,100 species, usually tropical or subtropical.

No species of Amaryllidaceae are indigenous in Fiji, but several occur in cultivation and at least one has become naturalized. In addition to the species discussed below, *Zephyranthes candida* (Lindl.) Herbert, *Z. rosea* (Spreng.) Lindl., and *Stenomeson croceum* (Savigny) Herbert have been mentioned as cultivated in other parts of the Fijian Region and may well be expected in Fiji.

KEY TO GENERA

Corona absent, the filaments without scales or teeth between them; flowers large and showy, borne several together, the perianth with a long tube, the stamens inserted in throat of perianth tube, the ovules numerous; peduncle solid. 1. *Crinum*

Corona present, formed by expanded petaloid filaments (“false corona”) or by scales between filaments. “False corona” present, formed by basally expanded filaments; peduncle solid.

Filaments much broadened or connected by a membrane, this funnelliform or cupuliform, above base of perianth segments 2–5 cm. long; ovules only in lowermost parts of locules; leaf blades without pellucid cross veins. 2. *Hymenocallis*

Filaments basally broadened and there connected by a short membrane.

Leaf blades without obvious cross veins between the main veins; inflorescences 2-10-flowered; perianth tube above ovary 35-60 mm. long, often curved; ovules usually 6 or more (rarely 2) per locule. 3. *Eucharis*

Leaf blades with very fine, close, cross veins between the main veins; inflorescences 6-30-flowered; perianth tube above ovary 8-35 mm. long, straight; ovules 2 per locule. 4. *Eurycles*

True corona present, formed of small scales between filaments; peduncle fistular at least in upper half, the cavity sometimes small but distally perceptible; inflorescences 2-many-flowered, the flowers large, the perianth segments basally connate, considerably longer than tube; ovary forming a distinct angle with pedicel, the ovules numerous and superposed in each locule. 5. *Hippeastrum*

1. *CRINUM* L. Sp. Pl. 291. 1753; Seem. Fl. Vit. 305. 1868.

Herbs with a subterranean bulb, often with a thick superterranean spurious stem, the leaves sessile, linear or lanceolate; peduncle compressed, solid, with 2 large apical bracts and smaller ones between flowers; flowers showy, umbelliform or headlike, pedicellate or subsessile, the perianth with a long, straight or curved tube, the segments linear, lanceolate or oblong; stamens inserted in throat of perianth tube, the filaments free, filiform, the anthers medifixed, linear; ovary 3-celled, the ovules closely sessile or immersed in placenta, the style filiform, the stigma capitate, small; fruit subglobose-obovoid, at length irregularly dehiscent, the seeds large.

LECTOTYPE SPECIES: *Crinum americanum* L. (vide Britton & Wilson, Sci. Surv. Porto Rico 5: 160. 1923), one of Linnaeus's four original species.

DISTRIBUTION: Tropics and subtropics, especially on sea coasts, with 100 or more species, of which one is cultivated and naturalized in Fiji.

1. *Crinum asiaticum* L. Sp. Pl. 292. 1753; Seem. in Bonplandia 9: 260. 1861, Viti, 443. 1862, Fl. Vit. 305. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 316. 1892; Yuncker in Bishop Mus. Bull. 178: 34. 1943, in op. cit. 184: 29. 1945, in op. cit. 220: 81. 1959; J. W. Parham, Pl. Fiji Isl. 268. 1964, ed. 2. 364. 1972; Sykes in New Zealand Dept. Sci. Indust. Res. Bull. 200: 218. 1970; B. E. V. Parham in New Zealand Dept. Sci. Indust. Res. Inform. Ser. 85: 64. 1972.

The *Crinum* commonly seen in Fiji is a coarse herb to 2 m. high with a spurious stem to 50 cm. high and 15 cm. in diameter, bearing leaves and inflorescences in a crown at its apex; the leaves are often to 1 m. long and 15 cm. broad and the peduncle to 50 cm. long, with 25-30 flowers. The perianth tube is greenish, the lobes white, the filaments rich purple at least distally, the anthers yellow, and the style rich purple; the fruit is yellow-green. Fruits and flowers are seen throughout the year.

TYPIFICATION: Linnaeus gives three prior references, indicating the original material as from Malabar or Ceylon.

DISTRIBUTION: The species is widely cultivated and also naturalized; in Fiji it is found on sandy beaches and other coastal areas and is a popular plant in villages. It will thrive at elevations of 800 m. or more.

LOCAL NAMES AND USE: *Viavia* is the usual Fijian name; *lautalotalo* has been borrowed from Samoa. The species is widely used as an ornamental.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Nandarivatu and vicinity, Greenwood 626A, Vaughan 3252. NANDRONGA & NAVOSA: In villages, H. B. R. Parham 242. NAMOSI: Hills near Navua River, Greenwood 1051. NAITASIRE: Nawangambena, DA 1301; Central Road, Tothill 862. MBENGGA: Savusavukalou, Weiner 224. OVALAU: Lovoni Village, Smith 7671. WAKAYA: Bryan 614. VANUA LEVU: THAKAUNDROVE: Namale, DA 16895. VANUA LEVU without further locality, Seemann 640. ONGEA NDRIKI: Bryan 408. FIJI without further locality, Storck XXIII.

As usually construed, *Crinum asiaticum* is a variable and broadly interpreted species, possibly including *C. pedunculatum* R. Br., which Yuncker reports as cul-

tivated in Tonga. Several other species reported by Sykes as cultivated on Niue have not been seen in Fiji.

2. *HYMENOCALLIS* Salisb. in Trans. Hort. Soc. London 1: 338. 1812.

Herbs with a subterranean bulb, the leaves radical, narrow, oblong-linear; peduncle compressed, solid, the flowers umbelliform or headlike; perianth with a long tube and long, linear, white lobes; stamens inserted at top of perianth tube, basally connected by a broad membrane, the free parts of filaments filiform, not in-curved, the anthers medifixed; ovary 3-celled, the ovules usually 2 per cell, the style filiform, the stigma small; fruit fleshy, at length rupturing laterally, often 1-seeded, the seed large, with a thick, spongy testa.

LECTOTYPE SPECIES: *Hymenocallis littoralis* (Jacq.) Salisb. (*Pancratium littorale* Jacq.) (vide Britton & Wilson, Sci. Surv. Porto Rico 5: 160. 1924).

DISTRIBUTION: About 50 species in the warm parts of America. One species is cultivated in Fiji.

1. *Hymenocallis littoralis* (Jacq.) Salisb. in Trans. Hort. Soc. London 1: 338. 1812; Yuncker in Bishop Mus. Bull. 178: 35. 1943; J.W. Parham, Pl. Fiji Isl. 268. 1964, ed. 2. 364. 1972; Sykes in New Zealand Dept. Sci. Indust. Res. Bull. 200: 221. 1970; B.E.V. Parham in New Zealand Dept. Indust. Res. Inform. Ser. 85: 36. 1972.

Pancratium littorale Jacq. Select. Stirp. Amer. 99. t. 179, fig. 94. 1763.

As seen in Fiji, *Hymenocallis littoralis* is a coarse herb forming dense clumps about 1 m. high. The fragrant flowers have the perianth tube greenish and the lobes white; the filaments are green, paler at base and forming a white staminal cup; the anthers and style are green. Flowers have been noted in May and June.

TIPIFICATION: The type material was obtained by Jacquin on Tierrabomba Island, near Cartagena, Colombia.

DISTRIBUTION: This American plant is widely cultivated; it has become naturalized in many parts of the Pacific, but in Fiji it has been seen only in cultivation. It is substantially more frequent than indicated below.

LOCAL NAME AND USE: *Spider lily*; ornamental.

AVAILABLE COLLECTION: OVALAU: Lovoni Valley, cultivated, Smith 7670.

3. *EUCHARIS* Planch. in Fl. Serres Jard. Eur. 8: 107. 1852 or 1853.

Herbs with a subterranean bulb, the leaves radical, ovate or oblong, petiolate; peduncle solid, with apical bracts, the flowers umbelliform, few; perianth tube terete, somewhat curved, with an expanded throat, the segments oval or oblong; stamens inserted in throat of perianth, shorter than perianth segments, the filaments broadened basally into connate membranes; ovary 3-celled, the ovules 6 or 8 per cell, superposed and collateral, rarely 2; fruit deeply 3-lobed, at length dehiscent, the seeds 1-few, large.

TYPE SPECIES: *Eucharis candida* Planch. & Linden, the only original species.

DISTRIBUTION: About ten species in tropical South America. One species is cultivated in Fiji.

1. *Eucharis grandiflora* Planch. & Linden in Fl. Serres Jard. Eur. 9: 255. t. 957. 1853 or 1854; Yuncker in Bishop Mus. Bull. 178: 34. 1943, in op. cit. 220: 80. 1959; J.W. Parham, Pl. Fiji Isl. 268. 1964, ed. 2. 364. 1972; Sykes in New Zealand Dept. Sci. Indust. Res. Bull. 200: 220. 1970.

Eucharis grandiflora is a scapose herb with a bulbous base, about 50 cm. high, its fragrant flowers with white perianth segments, a yellowish green filament tube with white lobes and white free portions of filaments, cream-colored anthers, and a white ovary. It has been collected flowering only in July.

TIPIFICATION: The type was a cultivated plant introduced by Triana into Linden's greenhouse in Brussels, originally from El Chocó in Colombia.

DISTRIBUTION: Known to be cultivated in several Pacific archipelagoes, and said by Parham to have been an early introduction into Fiji and now commonly cultivated there.

LOCAL NAMES AND USE: *Eucharis lily*; *Amazon lily*; ornamental.

AVAILABLE COLLECTION: VITI LEVU: NAITASIRI: Plant Introduction and Quarantine Station, Nanduruloulou, DA 12156.

4. EURYCLES Salisb. in Trans. Hort. Soc. London 1: 337. 1812, ex J.A. & J.H. Schultes in Roemer & Schultes, Syst. Veg. 7: Ivi, 909. 1830.

Proiphys Herbert, Appendix, 42. 1821.

Herbs with a subterranean bulb, the leaves radical, petiolate, the blade reniform-cordate or elliptic or oblong-lanceolate, when dry membranous, the main veins connected by thin cross veins forming a conspicuous reticulum; peduncle solid, the flowers umbelliform, numerous; perianth funnellform, the tube narrow, the segments often spreading, oblong to obovate; stamens inserted in throat of perianth, shorter than perianth segments, the filaments broadened at base and there connate, the narrow parts of filaments inserted in apical sinuses of the broadened part, the anthers medifixed; ovary 3-celled, the ovules 2 per cell, ascending from base, the style filiform, the stigma small; capsule globose, somewhat fleshy, often 1-seeded.

TYPE SPECIES: *Eurycles sylvestris* Salisb., nom. illeg. = *E. amboinensis* (L.) Lindl. (*Pancratium amboinense* L.). The type species of *Proiphys* is indicated as *P. amboinensis* (L.) Herbert, based on the same Linnaean species. Apparently Herbert overlooked Salisbury's publication or thought it invalid; actually it was valid as part of a descriptio generico-specifica.

DISTRIBUTION: Three species of Malesia and northeastern Australia; one species is widely cultivated in the Pacific.

1. *Eurycles amboinensis* (L.) Lindl. in Loudon, Encycl. Pl. 242. 1829; Sykes in New Zealand Dept. Sci. Indust. Res. Bull. 200: 220. 1970; J.W. Parham, Pl. Fiji Isl. ed. 2. 364. 1972.

Pancratium amboinense L. Sp. Pl. 291. 1753; Sims in Bot. Mag. 35: t. 1419. 1811.

Eurycles sylvestris Salisb. in Trans. Hort. Soc. London 1: 337, nom. illeg. 1812; Yuncker in Bishop Mus. Bull. 178: 34. 1943.

This bulbous-based herb has cream-white perianth segments; the flowers are not fragrant. Flowers in Fiji have been noted only in October.

TIPIFICATION: Linnaeus based his species on material from Amboina, "Comm. hort. 1. p. 77. t. 39." Salisbury also based his concept on *Pancratium amboinense*, but he did not make the appropriate combination.

DISTRIBUTION: Malesia; widely cultivated in Pacific archipelagoes but uncommon in Fiji.

LOCAL NAME AND USE: This ornamental is often known as *Brisbane lily*, but no name was indicated as used in Fiji.

AVAILABLE COLLECTION: VITI LEVU: REWA: Suva Botanical Gardens, DA 11794.

5. *Hippeastrum* Herbert, Appendix, 31. 1821. Nom. cons.

Herb with a subterranean bulb, the leaves linear to lanceolate to ligulate, the peduncle fistular at least distally, with apical bracts, the flowers (1-) 2-many, umbelliform, large, zygomorphic, nodding; perianth tube short or long, the corona scales very small; stamens inserted just below top of perianth tube, second, the filaments filiform, the anthers medifixed; ovary 3-celled, the ovules numerous and superposed in each cell, the style long, curved, the stigma capitate or shortly 3-fid; capsule globose or ellipsoid, loculicidally 3-valved, the seeds flat, black.

TYPE SPECIES: *Hippeastrum reginae* (L.) Herbert (*Amaryllis reginae* L.). Typ. cons.

DISTRIBUTION: About 75 species in tropical and subtropical America. Many species are extensively cultivated, but only one has been recorded from Fiji.

1. *Hippeastrum puniceum* (Lam.) Urb. Symb. Antill. 4: 151. 1903.

Amaryllis punicea Lam. Encycl. Méth. Bot. 1: 122. 1783.

Amaryllis equestris Ait. Hort. Kew. 1: 417. 1789.

Hippeastrum equestre Herbert, Appendix, 31. 1821; J. W. Parham, Pl. Fiji Isl. 268. 1964, ed. 2. 364. 1972.

This often cultivated plant is an herb with a basal bulb, the peduncle being up to 60 cm. high; the perianth segments are red or salmon-colored, paler to green at base.

TYPIIFICATION AND NOMENCLATURE: The type of *Amaryllis punicea*, presumably at P, was indicated to be from "Surinam, Cayenne, and in the Antilles." *Amaryllis equestris* is typified by a cultivated plant grown at K, introduced from the West Indies in 1778 by William Pitcairn.

DISTRIBUTION: Tropical America, now widely cultivated. I have seen no herbarium vouchers from Fiji, but Parham indicates it to have been an early introduction now grown in many gardens.

LOCAL NAMES AND USE: *Red lily* (Parham), but usually known as *Barbados lily*; it is a striking ornamental.

FAMILY 18. PHILESIACEAE

PHILESIACEAE Dumort. Anal. Fam. Pl. 53, 54, as *Phylesiaceae*. 1829.

Shrubs or climbers, the leaves alternate, oblong to ovate or lanceolate, the blades with prominent parallel nerves; flowers ♂, actinomorphic, terminal or axillary, solitary to cymose-racemose, the perianth segments free or connivent or connate, subequal or in calycine and petaloid series; stamens 6, hypogynous or borne on perianth tube, the filaments free or partially connate, the anthers dorsifixed, dehiscent by introrse or sublateral longitudinal slits; ovary superior, 1- or 3-locular, with axile or parietal placentas, the style with a capitate or shortly 3-lobed stigma, the ovules few to numerous; fruit a berry.

DISTRIBUTION: A small Southern Hemisphere family composed of seven genera and nine species, including the beautiful *Lapageria rosea* Ruiz & Pavon, the national flower of Chile. One species occurs indigenously in Fiji.

1. *GEITONOPLESIMUM* A. Cunn. ex R. Br. in Hook. in Bot. Mag. 59: t. 3131. 1832.

Luzuriaga sect. *Geitonoplesium* Hall. f. in Nova Guinea 8: 991. 1914; Krause in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. 15a: 379. 1930.

Slender, sprawling vines or climbing shrubs, the leaves with short petioles and lanceolate blades; inflorescence a terminal panicle with flowers in scattered fascicles or cymes; perianth segments essentially free, spreading, distinctly nerved, not cili-

ate; anthers oblong-linear; ovary 3-locular; fruit at length irregularly breaking into 3 valves, the seeds few, shining, black, partially surrounded by pale green pulp.

TYPE SPECIES: *Geitonoplesium cymosum* (R. Br.) A. Cunn. ex Hook. (*Luzuriaga cymosa* R. Br.).

DISTRIBUTION: Philippine Islands and eastern Malesia to New Caledonia, the New Hebrides, and Fiji, usually considered to include a single polymorphic species. As Fiji is the eastern terminus of the range, I should have included it in my discussion in J. Arnold Arb. 36: 273-292. 1955.

1. *Geitonoplesium cymosum* (R. Br.) A. Cunn. ex Hook. in Bot. Mag. 59: t. 3131. 1832; Seem. in Bonplandia 9: 260. 1861, Viti, 443. 1862, Fl. Vit. 312. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 318. 1892; Gibbs in J. Linn. Soc. Bot. 39: 178. 1909; Turill in op. cit. 43: 39. 1915; Guillaumin in J. Arnold Arb. 13: 111. 1932; J. W. Parham, Pl. Fiji Isl. 265. 1964, ed. 2. 358. fig. 98. 1972. FIGURE 49.

Luzuriaga cymosa R. Br. Prodr. Fl. Nov. Holl. 282. 1810.

In Fiji *Geitonoplesium cymosum* is found at elevations of 130-1,323 m. (or cultivated near sea level), in hillside thickets, in dense forest and on its edges, on grassy slopes, and in dense crest thickets. It is a vine, with slender, wiry, climbing or scrambling stems. The fragrant flowers have white or cream-colored perianth segments, greenish white filaments, and yellow anthers; the fruit, at first yellow, becomes orange when ripe and has black, glossy seeds. Flowers and fruits are found throughout the year.

TIPIFICATION: The holotype was collected by Brown (BM) in New South Wales or Queensland.

DISTRIBUTION: As of the genus; it is frequent in Fiji and I have examined more than 40 collections. The foliage variation is striking, the leaves of Fijian specimens varying from 5 to 35 mm. in width. Leaf blades as narrow as 3 mm. have been noted in Australia and New Guinea and as broad as 40 mm. in the New Hebrides. However, these differences are no doubt due to light intensity in part, as the variation on a single individual may be pronounced.

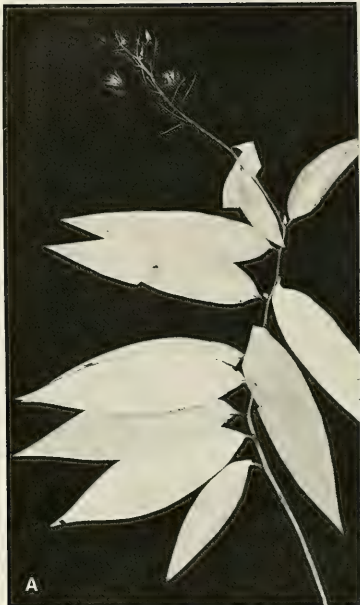
LOCAL NAMES AND USES: The most frequently used names in Fiji are *wa mbitu-mbitu* and *wa ndakua*; also recorded are *wa ula* and *haveavea*. The species is locally used as an ornamental on trellises and nettings; pieces of the hard stems are sometimes used to make pegs or nails. In Australia, where the species is also used ornamentally, it is known as *scrambling lily*.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Mt. Evans Range, *Greenwood 448C*; Mt. Nairoso, eastern flank of Mt. Evans Range, *Smith 4005*; vicinity of Nandarivatu, *Gibbs 564*, in *Thurn 85*, *Degener & Ordenez 13546*; summit of Mt. Nanggaranambuluta, *Smith 4848*; summit of Mt. Tomanivi, *DA 7102*. NANDRONGA & NAVOSA: Nausori Highlands, *DA 12673* (*Melville et al. 7049*); between Naloka and Koronayalewa, *DA 1389*; Tonuve, *H. B. R. Parham 148*. SERUA: Namboutini, *DA 13706*. NAMOSI: Wayauyau Creek, *DA 14247*. NAITASIRE: Prince's Road, *Vaughan 3286*. REWA: Suva, Department of Agriculture compound, cultivated, *DA 12081*. VANUA LEVU: MATHUATA-THAKAUNDROVE boundary: Mt. Ndelaikoro, *Krauss 443*. THAKAUNDROVE: Mt. Mbatini, crest of range, *Smith 637*. THIKOMBIA: *Tohill 901*. FIJI without further locality, *Seemann 638*.

FAMILY 19. ASPARAGACEAE

ASPARAGACEAE Juss. Gen. Pl. 40, as *Asparagi*. 1789.

Rootstock a rhizome with aerial shoots, the leaves reduced to scariose and often minute scales bearing modified branchlets (cladophylls) in their axils, these acicular or flat; inflorescences fascicular, racemose, or subumbellate, the flowers ♂, the



pedicels articulated distally; perianth segments and stamens 6, free or essentially so, the anthers dorsifixed, 2-lobed, introrse; ovary 3-locular, the ovules 2 or more in each locule, the styles free or connate; fruit a globose berry with solitary or few seeds.

DISTRIBUTION: Composed of a single genus in tropical and temperate regions of the Old World.

1. *ASPARAGUS* L. Sp. Pl. 313. 1753; Baker in J. Linn. Soc. Bot. **14**: 594. 1875; Krause in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. **15a**: 362. 1930.

Characters of the family.

LECTOTYPE SPECIES: *Asparagus officinalis* L. (vide Britton & Brown, Ill. Fl. N. U. S. ed. 2. **1**: 313. 1913), one of Linnaeus's original ten species.

DISTRIBUTION: As of the family, with about 300 species, including the well-known edible *Asparagus officinalis* and several ornamental species, one of which is recorded in Fiji. In addition to this, however, it would seem that the cultivated garden asparagus must sometimes be grown in Fiji, and also other popular ornamental species; *A. sprengeri* Regel and *A. scandens* Thunb., which are reported from Niue, may also be anticipated in cultivation in Fiji.

1. *Asparagus plumosus* Baker in J. Linn. Soc. Bot. **14**: 613. 1875; Christophersen in Bishop Mus. Bull. **128**: 50. 1935; Yuncker in op. cit. **178**: 32. 1943, in op. cit. **184**: 29. 1945, in op. cit. **220**: 79. 1959; J. W. Parham, Pl. Fiji Isl. 263. 1964, ed. 2. 357. 1972; Sykes in New Zealand Dept. Sci. Indust. Res. Bull. **200**: 254. 1970; B. E. V. Parham in New Zealand Dept. Sci. Indust. Res. Inform. Ser. **85**: 58. 1972.

In Fiji this widely grown species occurs only near sea level, as a vine with a slender, woody, climbing, thorny stem; the cladophylls are filiform and less than 1 cm. long. It has white flowers and a blackish fruit.

TYPIFICATION: I have not noted a lectotypification among the three specimens from southern Africa originally cited by Baker: *Drege 4482*, *Cooper 202*, and *Gerrard & M'Ken 754*.

DISTRIBUTION: A species of southern Africa, now widely cultivated and also naturalized in many warm countries. Although reported as naturalized in Tonga and Samoa, it has been seen only cultivated in Fiji.

LOCAL NAME AND USE: *Asparagus fern*; ornamental.

AVAILABLE COLLECTIONS: VITI LEVU: NAITASIRI: Koronivia, DA 11233, 12136. REWA: Suva, DA, Dec. 30, 1949. KANDAVU: Vunisea, DA 9643.

FAMILY 20. SMILACACEAE

SMILACACEAE Vent. Tabl. Règne Vég. **2**: 146, as *Smilacae*. 1799.

Climbing or straggling shrubs, usually dioecious, the stems and branches often prickly, the leaves alternate or opposite, the petioles sometimes tendrillous, the blades often coriaceous, usually with 3 or 5 principal nerves from base, reticulate-veined; inflorescence an axillary umbel, raceme, or spike, the flowers actinomorphic, mostly unisexual, rarely ♀, small; perianth segments 6, essentially equal, free or

FIGURE 49. *Geitonoplesium cymosum*; A, flowering branch, broad-leaved form, × 1/3; B, terminal branch with young inflorescences, narrow-leaved form, × 1/3; C, flower with 2 outer perianth segments removed, × 6; D, irregularly dehiscent fruit, with 3 seeds partially embedded in pale pulp, × 2; A & C from Smith 637, B from Degener & Ordóñez 13546, D from Smith 4848.

rarely united into a tube; stamens usually 6, rarely as few as 3 or as many as 18 in ♂ flowers, the filaments free or united into a column, the anthers 1-locular by confluence of locules, introrse, the ♂ flowers lacking a vestigial ovary; ♀ flowers often with staminodes, the stigmas recurved, the ovary superior, sessile, 3-locular, the ovules 1 or 2 in each locule, pendulous, orthotropous or semi-anatropous; fruit a berry, the seeds usually 1-3, with a small embryo and hard endosperm.

DISTRIBUTION: Four genera and nearly 400 species in tropical and temperate regions.

1. *SMILAX* L. Sp. Pl. 1028. 1753; Seem. Fl. Vit. 309. 1868; A. DC. in DC. Monogr. Phan. 1: 45. 1878; Krause in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. 15a: 382. 1930.

Pleiosmilax Seem. in J. Bot. 6: 193. July 1, 1868, Fl. Vit. 309. Oct. 1, 1868.

Smilax sect. *Pleiosmilax* A. DC. in DC. Monogr. Phan. 1: 203. 1878; Krause in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. 15a: 385. 1930.

Diocious, robust, climbing shrubs, the stems often with recurved, hooked prickles; petioles broadened proximally and bearing 2 caducous tendrils; flowers unisexual, borne in umbels; perianth segments free, the stamens in our species rarely as few as 4, usually 8-18; ♀ flowers in our species with 6 staminodes.

LECTOTYPE SPECIES: *Smilax aspera* L. (vide Britton & Brown, Ill. Fl. N. U.S. ed. 2. 1: 527. 1913), one of Linnaeus's original 13 species. I have not noted a lectotypification of *Pleiosmilax*, originally described with three species, all of which were retained by de Candolle in his sect. *Pleiosmilax*. It is probable that Seemann's concept was in large part based on *P. vitiensis*, which I herewith designate as the lectotype species.

DISTRIBUTION: About 350 species in tropical, subtropical, and temperate areas.

In describing *Pleiosmilax*, Seemann indicated that its ♂ flowers have either 12 or 18 stamens, rather than the 6 characteristic of *Smilax*. However, the number of stamens in *S. vitiensis* varies from 4 to 18, and the character seems of little consequence in distinguishing either a genus or section, as indicated by me in Allertonia 1: 334. 1978. The size of perianth segments is also highly variable.

1. *Smilax vitiensis* (Seem.) A. DC. in DC. Monogr. Phan. 1: 204. 1878; Drake, Ill. Fl. Ins. Mar. Pac. 318. 1892; Gibbs in J. Linn. Soc. Bot. 39: 178. 1909; Turrill in op. cit. 43: 39. 1915; Guillaumin in J. Arnold Arb. 13: 111. 1932; Yuncker in Bishop Mus. Bull. 220: 80. 1959; J. W. Parham, Pl. Fiji Isl. 265. 1964, ed. 2. 358. fig. 97. 1972; A. C. Sm. in Allertonia 1: 334. 1978.

FIGURE 50.

Smilax sp. Seem. in Bonplandia 9: 260. 1861, Viti, 443. 1862.

Pleiosmilax vitiensis Seem. in J. Bot. 6: 193. July 1, 1868, Fl. Vit. 310. t. 93. Oct. 1, 1868.

Smilax trifurcata Seem. in J. Bot. 6: 257. Sept. 1, 1868, Fl. Vit. 309. Oct. 1, 1868; A. DC. in DC. Monogr. Phan. 1: 23, 206. 1878; Drake, Ill. Fl. Ins. Mar. Pac. 318. 1892.

Pseudosmilax vitiensis Seem. ex Turrill in J. Linn. Soc. Bot. 43: 39, pro syn. 1915.

The Fijian *Smilax* is locally abundant (more than 100 collections having been studied) at elevations from near sea level to 1,300 m. in thickets, various types of forest, and in ridge and crest vegetation. It is a climbing shrub or liana, often high-climbing, the stems being usually smooth but rarely with a few inconspicuous prickles. The petiole is broadened in its lower 2-15 mm., there bearing conspicuous tendrils. The leaf blades are very variable, sometimes as large as 30 × 22 cm. but usually much smaller, predominantly ovate and 5-nerved from the cordate to obtuse base, although sometimes a sixth and seventh nerve are discernible. The perianth segments are pale to yellowish green, sometimes with purplish markings; the filaments, anthers, and ovary are also pale to greenish yellow; and the fruit is deep purple to black at maturity. Flowers and fruits occur throughout the year.

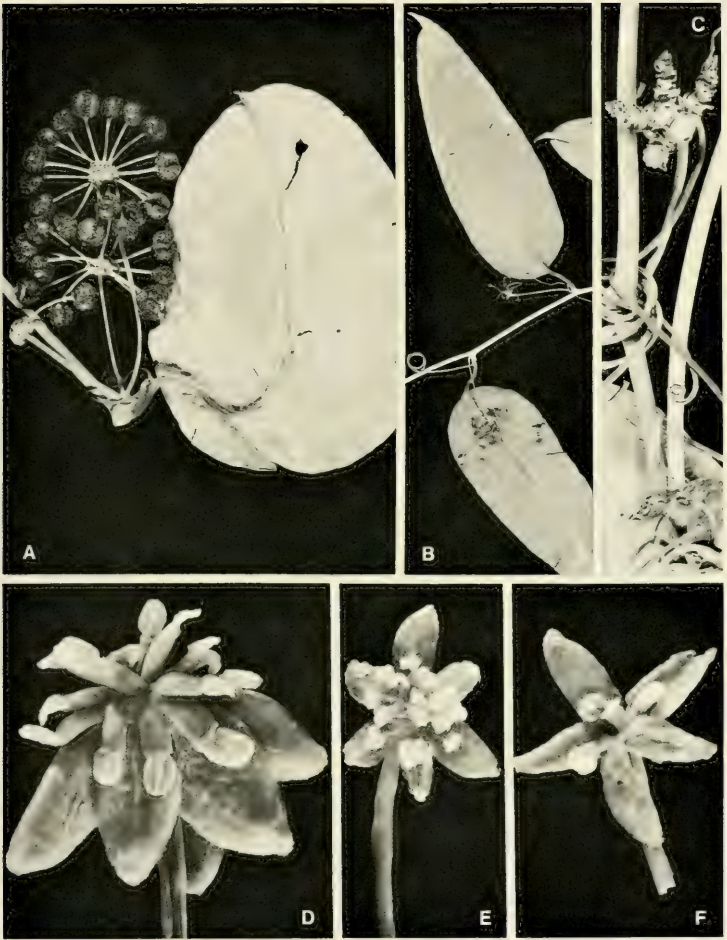


FIGURE 50. *Smilax vitiensis*; A, fruit and typical leaf, showing tendrillous petiole, $\times 1/2$; B, narrow-leaved form, showing δ inflorescences and tendrillous petioles, $\times 1/2$; C, aberrant form of inflorescence ("*S. trifurcata*" type), $\times 2$; D-F, δ flowers, showing variation in flower size and number of stamens, all $\times 6$; A, from Smith 7270, B & E from Gillespie 4031, C from Gillespie 2093, D from Smith 1135, F from Gillespie 4102.

TYPIIFICATION AND NOMENCLATURE: The holotype of *Pleiosmilax vitiensis* is *Seemann 631*, p. p. (K), said to have been obtained on Ovalau, Vanua Levu, Viti Levu, and Kandavu; the two sheets at K, not labelled as to locality, are best taken together as the holotype. The holotype of *Smilax trifurcata* is *Seemann 631*, p. p. (BM), from Ovalau; Seemann segregated this portion of his material because the receptacles are 3-furcate instead of subglobose, each branch being 5–12 mm. long and with crowded, imbricate bracts under small scars which evidently mark the fallen fruits. De Candolle retained both species, suggesting that *S. trifurcata* might be merely a "monstrosity." In fact, it seems to be merely an aberrant form not worthy of recognition, as I suggested in 1978.

DISTRIBUTION: Although very abundant in Fiji, *Smilax vitiensis* also occurs occasionally in Tonga and the New Hebrides. Guillaumin (1932, cited above) also indicated its occurrence in the Bismarck Islands without citing material; and Seemann also reported it from Samoa. Personally I have seen no material from groups west of the New Hebrides that seem to belong here, and its presence in Samoa is unlikely (B. E. V. Parham saw no Samoan specimens but merely recorded the earlier report in New Zealand Dept. Sci. Indust. Res. Inform. Ser. 85: 109. 1972).

LOCAL NAMES AND USES: The most commonly used Fijian name is *wa rusi*, but the following are also reported: *takataka*, *kandrangi*, *kundrangi*, *wa mbitumbitu*, *wa me*, *wa rusarusa*, *nakauwa*, *suthumaekaka*, and *suthumeikaka*. The strong, slender stems are used for tying and for making baskets and fish nets.

REPRESENTATIVE COLLECTIONS: YASAWAS: WAYA: Olo Creek, north of Yalombi, *St. John 18025*. VITI LEVU: MBA: Mt. Evans Range, *Greenwood 261E*; Nandarivatu, *Gibbs 645*, *im Thurn 287*; Mt. Nangaranambuluta, *O. & I. Degener 32003*; Mt. Tomanivi, *DA 12692 (Melville et al. 7080)*. NANDRONGA & NAVOSA: Northern portion of Rairaimatuku Plateau, *Smith 5419*. SERUA: Hills between Ngaloa and Wainiyambia, *Smith 9375*. NAMOSI: Mt. Naitarandamu, *Gillespie 3090, 4102*; Mt. Voma, *Gillespie 2786*. RA: Mountains near Penang, *Greenwood 261D*. NAITASIRE: Matawailevu, Wainimala River Valley, *St. John 18212*; Tamavua, *Yeoward 86*. TAILEVU: Naivithula, Wainivesi River, *Hotta 3169*. REWA: Mt. Korombamba, *DA 16507*; between Suva and Lami, *Gillespie 2093* (aberrant form, "*S. trifurcata*" type). KANDAVU: Hills above Namalata and Ngaloa Bays, *Smith 91*. OVALAU: Hills east of Lovoni Valley, *Smith 7270*. KORO: Eastern slope of main ridge, *Smith 995*. NGAU: Hills east of Herald Bay, *Smith 7787*. VANUA LEVU: MBUA: Koromba Forest, *DA 15148*. MATHUATA: Mathuata coast, *Greenwood 261B* (Dec. 30, 1923); Wainikoro River, *Greenwood 261B* (March 10, 1925). THAKAUNDOVE: Wainigata, *DA 13129*. TAVEUNI: Summit of Mt. Uluingalau, *Smith 906*. MOALA: *Bryan 303*. FULANGA: On limestone formation, *Smith 1135*.

In 1978 (cited above) I mentioned that certain specimens have comparatively narrow and glossy leaf blades, seemingly 3-nerved but actually with a very inconspicuous fourth and fifth nerve. These specimens are:

VITI LEVU: MBA: Vicinity of Nandarivatu, *Gillespie 4031*, *Degener 14289*; Sovutawambu, *Degener 14599*; Nandala, *Degener 15017*. NAITASIRE: Prince's Road, *DA 7572*; Tholo-i-suva, *DA 9833*; Central Road, *Tothill 504*, *MacDaniels 1159*; Tamavua, *Gillespie 2428*. REWA: Mt. Korombamba, *Parks 20104*. VITI LEVU without further locality, *Parks 20867*. VANUA LEVU: THAKAUNDOVE: Mt. Mariko, *Smith 445*.

Since this group of specimens seems to have no geographical or environmental cohesion, and since a few intermediates occur, I think it unwise to designate it nomenclaturally at any level.

FAMILY 21. DIOSCOREACEAE

DIOSCOREACEAE R. Br. Prodr. Fl. Nov. Holl. 294, as *Dioscoreae*. 1810.

Dioecious climbing vines with twining stems, or rarely shrubs, with tubers or rhizomes; leaves alternate, rarely opposite, petiolate, the blades often cordate, net-

veined, entire or digitately divided; inflorescence usually racemose, the flowers small, actinomorphic, the perianth campanulate or spreading, with 6 lobes in 2 series; stamens of ♂ flowers 6, or 3 with 3 staminodes, the stamens attached to base of perianth, the filaments free or shortly connate, the anthers 2-locular, the locules contiguous or separated, a rudimentary ovary present or absent; ♀ flowers often with 6 staminodes, the ovary inferior, usually 3-locular with 2 ovules in each locule, these anatropous, superposed on axile placentas, the styles free or connate with short stigmas; fruit a 3-lobed capsule or berry, the seeds often winged, with endosperm and a small embryo.

DISTRIBUTION: Tropics and warm temperate regions; usually considered to include 5–7 genera and about 750 species. One genus, *Dioscorea*, provides a staple carbohydrate food in its tubers and plays an important role in Fijian life.

I. DIOSCOREA L. Sp. Pl. 1032. 1753; Seem. Fl. Vit. 305. 1868; Knuth in Pflanzenr. **87** (IV. 43): 45. 1924; Prain & Burkill in Ann. Bot. Gard. Calcutta **14**: 1. 1936; Burkill in Fl. Males. I. **4**: 293. 1951; Barrau in Bishop Mus. Bull. **219**: 43. 1958.

Large perennials, the stems twining dextrorsely or sinistrorsely, sometimes annual, sometimes winged, often aculeate, arising from tubers, not enlarged at base above ground, frequently with small, axillary bulbils; fruit a deeply 3-lobed capsule, the lobes flat, winglike, the seeds 1 or 2 per locule, winged.

LECTOTYPE SPECIES: *Dioscorea sativa* L. (vide Britton & Brown, Ill. Fl. N. U.S. ed. 2. **1**: 535. 1913), one of Linnaeus's original eight species.

DISTRIBUTION: About 600 species in tropical and subtropical areas. It may be noted that no species or section of *Dioscorea* is common to both the Old and the New World, indicating that the genus evolved independently in each area from early geological times. The five species known in Fiji, although all of them except *D. esculenta* are thoroughly naturalized, were apparently aboriginal introductions from southeastern Asia by way of Malesia; conceivably *D. pentaphylla* is indigenous in Melanesia. The most palatable species, *D. alata*, is not now known in a wild state, but it was probably first brought into cultivation in southeastern Asia.

In addition to the five Old World species in Fiji, *Dioscorea floribunda* Mart. & Gal. (in Bull. Acad. Roy. Sci. Brux. **9**: 391. 1842), a Mexican species, should be noted as a recent introduction into Fiji. It was probably accidentally introduced with rice and is not persistent, although it has been grown in trial plots (cf. J. W. Parham, Pl. Fiji Isl. ed. 2. 365. 1972) and is represented by DA 15373, from the Nausori rice mill, Tailevu Province, Viti Levu. This material was kindly identified by Drs. B. G. Schubert and A. Gómez Pompa.

USEFUL TREATMENTS OF GENUS: Knuth, R. Dioscoreaceae, Pflanzenr. **87** (IV. 43): 1–387. 1924. Prain, D., & I. H. Burkill. An account of the genus *Dioscorea* in the East. Part I. The species which twine to the left. Ann. Bot. Gard. Calcutta **14**: 1–210. 1936; Part II. The species which twine to the right: with addenda to part I, and a summary. Op. cit. **14**: 211–528. 1939 (a monumental and definitive work, freely illustrated). Burkill, I. H. Dioscoreaceae. Fl. Males. I. **4**: 293–335. 1951. Burkill, I. H. *Dioscorea*. Dict. Econ. Prod. Malay Penins. ed. 2. 824–838. 1966. Purseglove, J. W. *Dioscorea*. *Tropical Crops: Monocotyledons*, 97–117. 1972. Seemann's review of the species in Fiji (Fl. Vit. 305–308. 1868) is a valuable local treatment.

KEY TO SPECIES¹

Stems twining to the left (i.e. with clockwise circumnutation); leaves in our species alternate; staminate flowers usually pedicelled.

¹Largely adapted from Burkill, 1951, cited above.

Leaves simple.

- Stems prickly, the prickles remaining at least in the position of stipules; plant abundantly pilose with T-shaped hairs; tepals on a broadened torus; capsules nearly as broad as long, the seeds evenly winged all around (sect. *Combilium*). 1. *D. esculenta*
- Stems not prickly; indument usually absent, or the hairs inconspicuous, not T-shaped; tepals free, on the end of the pedicel; capsules long-elliptic, the seeds winged toward the base of the cell (sect. *Opsophyton*). 2. *D. bulbifera*
- Leaves 3-5-foliolate, pubescent, the indument deep rusty-red or dirty white; stems usually abundantly prickly in the lowest internodes, pubescent but glabrate (sect. *Lasiophyton*). 3. *D. pentaphylla*
- Stems twining to the right (i.e. with counterclockwise circumnutation); leaves in our species usually opposite; plants glabrous; staminate flowers sessile (sect. *Enantiophyllum*). 4. *D. alata*
- Stems not angled, armed, sometimes abundantly so toward base, with some prickles often persisting in the position of stipules; axis of staminate spikes not zigzag; staminate flowering axes 1-4 together, aggregated on often elongated downwardly directed leafless branches. 5. *D. nummularia*

1. ***Dioscorea esculenta*** (Lour.) Burkill in Gard. Bull. Straits Settlement. 1: 396. pl. 7-9. 1917; Knuth in Pflanzenr. 87 (IV. 43): 189. 1924; Merr. in Trans. Amer. Philos. Soc. n. s. 24 (2): 113. 1935; Prain & Burkill in Ann. Bot. Gard. Calcutta 14: 80. pl. 35-37, 82. 1936; B.E.V. Parham in Agr. J. Dept. Agr. Fiji 13: 40. 1942; Yuncker in Bishop Mus. Bull. 178: 37. 1943; Burkill in Fl. Males. I. 4: 307. fig. 5c, 6a. 1951; Yuncker in Bishop Mus. Bull. 220: 83. 1959; J. W. Parham, Pl. Fiji Isl. 269. 1964, ed. 2. 365. 1972; Sykes in New Zealand Dept. Sci. Indust. Res. Bull. 200: 231. 1970; B.E.V. Parham in New Zealand Dept. Sci. Indust. Res. Inform. Ser. 85: 136. 1972; St. John in Phytologia 36: 368. 1977.

Dioscorea aculeata sensu L. Herb. Amb. 23. 1754, Amoen. Acad. 4: 131, p. p. 1754; Seem. in Bonplandia 9: 260. 1861, Viti, 443. 1862, Fl. Vit. 308. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 317. 1892; non L., 1753.

Oncus esculentus Lour. Fl. Cochinch. 194. 1790.

Dioscorea esculenta var. *fulvido-tomentosa* Knuth in Pflanzenr. 87 (IV. 43): 190. 1924.

In Fiji *Dioscorea esculenta* is cultivated near sea level in the dry zones.

TYPEIFICATION: *Oncus esculentus* is typified by a collection of Loureiro (BM holotype) from the vicinity of Hue, Vietnam.

DISTRIBUTION: Doubtless a native of southeastern Asia, this species is now widely cultivated. It is probably more frequent in Fiji than the paucity of collections indicates.

LOCAL NAMES AND USE: *Kawai* is the usual Fijian name, but *hina* is also recorded. Elsewhere this species is often known as the *lesser yam*. It does not produce flowers or fruits in Fiji and is not naturalized. The tubers are considered excellent; they are comparatively small but are white and have a sweet texture when cooked. While this species does not equal *Dioscorea alata* in usefulness, it can be raised where the humid season is short and a return taken in six months.

AVAILABLE COLLECTIONS: VITI LEVU: NAITASIRI: Prince's Road, Meebold 26630. LAKEMBA: Tumbou River forks, Garnock-Jones 840. FIJI without further locality, Seemann 629.

2. ***Dioscorea bulbifera*** L. Sp. Pl. 1033. 1753; Knuth in Pflanzenr. 87 (IV. 43): 88. fig. 19, F-L. 1924; Guillaumin in J. Arnold Arb. 13: 111. 1932; Christophersen in Bishop Mus. Bull. 128: 53. 1935; Prain & Burkill in Ann. Bot. Gard. Calcutta 14: 111. pl. 49-51, 82. 1936; B.E.V. Parham in Agr. J. Dept. Agr. Fiji 13: 40. 1942; Yuncker in Bishop Mus. Bull. 178: 37. 1943, in op. cit. 184: 29. 1945; Burkill in Fl. Males. I. 4: 311. fig. 4a, b, 5f. 1951; Yuncker in Bishop Mus. Bull.

220: 82. 1959; J. W. Parham, Pl. Fiji Isl. 269. 1964, ed. 2. 365. 1972; Sykes in New Zealand Dept. Sci. Indust. Res. Bull. **200:** 231. 1970; St. John & A. C. Sm. in Pacific Sci. **25:** 343. 1971; B. E. V. Parham in New Zealand Dept. Sci. Indust. Res. Inform. Ser. **85:** 137. 1972.

Helmia bulbifera Kunth, Enum. Pl. **5:** 435. 1850; Seem. in Bonplandia **9:** 260. 1861, Viti, 443. 1862.

Dioscorea sativa sensu Seem. Fl. Vit. 308. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 317. 1892; non L.

In Fiji *Dioscorea bulbifera* is cultivated and also naturalized, occurring in various types of forest from near sea level to 900 m.; it is a scrambling or high-climbing vine, with the stems and petioles often reddish-tinged; the perianth segments are greenish yellow. Flowering has been noted from December to March and fruiting slightly later.

TYPIFICATION: Linnaeus gives several prior references and indicates "*Habitat in Indiis*."

DISTRIBUTION: In the wild this species is widely distributed in the tropics of Asia and Africa; in cultivation it has now spread from the Atlantic coast of Africa to the furthest islands of the Pacific and more recently into tropical America. In Fiji it is doubtless more abundant than the number of available collections would suggest.

LOCAL NAMES AND USES: The most frequent Fijian name is *kaile*, but also recorded are *kaile ndranu*, *kaile nganga*, *kaile manu*, *sarau*, *yam*, and *potato yam*; elsewhere it is often called *aerial yam*. The tuber is edible but is acrid and poisonous until soaked in running water prior to cooking; then it can be prepared as a mashed, thin, souplike dish. The tubers of wild plants become increasingly unpalatable as the time of new growth approaches.

AVAILABLE COLLECTIONS: YASAWAS: YASAWA: Mbukama, *DA 13650*. MAMANUTHAS: NGGALITO Island, Malolo Group, O. & I. Degener 31975. VITI LEVU: MBA: Lautoka, *Greenwood 267*; mountains near Lautoka, *Greenwood 406*; vicinity of Nandarivatu, *Degener 14303*. NANDRONGA & NAVOSA: Nausori Highlands, *DA 12664 (Melville et al. 7039)*. SERUA: Coastal hills in vicinity of Taunovo Creek, east of Wainiyambia, *Smith 9604*. NAITASIRI: Nasinu, *DA 7367*. REWA: Namboro, *DA 5942*; Vunikawai, *DA 6058*. MAKONGAI: Tothill 855. VANUA LEVU: THAKAUNDROVE: Natewa Peninsula, hills west of Mbutha Bay, *Smith 820*. LAKEMBA: Near Tumbou, *Garnock-Jones 890*. FIJI without further locality, *Seemann 626*, *Horne 302*, *DA 3903*.

3. *Dioscorea pentaphylla* L. Sp. Pl. 1032. 1753; Seem. in Bonplandia **9: 260. 1861, Viti, 443. 1862, Fl. Vit. 308. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 317. 1892; Knuth in Pflanzenr. **87** (IV. 43): 145. 1924; Christophersen in Bishop Mus. Bull. **128:** 53. 1935; Prain & Burkill in Ann. Bot. Gard. Calcutta **14:** 160. *pl. 66, 67*. 1936; B. E. V. Parham in Agr. J. Dept. Agr. Fiji **13:** 40. 1942; Yuncker in Bishop Mus. Bull. **178:** 37. 1943, in op. cit. **184:** 29. 1945; Burkill in Fl. Males. I. **4:** 315. *fig. 5g, 6c*. 1951; Yuncker in Bishop Mus. Bull. **220:** 83. 1959; J. W. Parham, Pl. Fiji Isl. 270. 1964, ed. 2. 366. 1972; Sykes in New Zealand Dept. Sci. Indust. Res. Bull. **200:** 231. 1970; St. John & A. C. Sm. in Pacific Sci. **25:** 344. 1971; B. E. V. Parham in New Zealand Dept. Sci. Indust. Res. Inform. Ser. **85:** 136. 1972.**

In Fiji *Dioscorea pentaphylla* is sparingly cultivated and also naturalized in thickets from near sea level to 200 m. It is an often high-climbing vine, with green perianth segments and with the young ovary finely purple-mottled. From the sparse records available it produces flowers in April and May.

TYPIFICATION: Linnaeus cited several references and indicated "*Habitat in India*."

DISTRIBUTION: The wetter parts of tropical Asia and eastward to extreme eastern Polynesia. It is questionable how far to the east this species is indigenous, but it

seems reasonable to assume that it was an aboriginal introduction to most Pacific Islands, probably including those of the Fijian Region.

LOCAL NAMES AND USE: *Tokulu*; *kaile tokatolu*; *tokatolu*; *kaile*; *wa kaile*; *mbulou*. The tubers are non-toxic and are edible but they are considered inferior and are probably used only in times of scarcity.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Vovono, *DA 14721*. TAILEVU: Hills east of Wainimbuka River, in vicinity of Ndakuivuna, *Smith 7109*. OVALAU: *Seemann 630*. FIJI without further locality, *U.S. Expl. Exped., DA 3429*.

4. *Dioscorea alata* L. Sp. Pl. 1033. 1753; Seem. in *Bonplandia* 9: 260. 1861, Viti, 443. 1862, Fl. Vit. 308. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 317. 1892; Knuth in *Pflanzenr.* 87 (IV. 43): 265. 1924; Christophersen in *Bishop Mus. Bull.* 128: 51. *fig. 7*. 1935; Prain & Burkill in *Ann. Bot. Gard. Calcutta* 14: 302. *pl. 123-125, 147*. 1939; B. E. V. Parham in *Agr. J. Dept. Agr. Fiji* 13: 39. 1942; Yuncker in *Bishop Mus. Bull.* 178: 35. 1943; Burkill in *Fl. Males. I. 4*: 330. 1951; Yuncker in *Bishop Mus. Bull.* 220: 82. 1959; J. W. Parham, *Pl. Fiji Isl.* 269. 1964, ed. 2. 365. 1972; Sykes in *New Zealand Dept. Sci. Indust. Res. Bull.* 200: 230. 1970; B. E. V. Parham in *New Zealand Dept. Sci. Indust. Res. Inform. Ser.* 85: 135. 1972; St. John in *Phytologia* 36: 368. 1977.

In Fiji *Dioscorea alata* is extensively cultivated and is also fully naturalized from near sea level to about 1,050 m. in dry or dense forest, on scrub-covered forehills, and on grass- and reed-covered slopes. It is a sprawling or often high-climbing vine, with yellow or greenish white perianth segments and yellow styles. Flowers and fruits have been noted from April through August.

TYPIFICATION: After giving several prior references Linnaeus indicates "*Habitat in Indiis*."

DISTRIBUTION: Although it is not known in a truly wild state, *Dioscorea alata* was probably first taken into cultivation in southeastern Asia and is now pantropical, often appearing fully naturalized.

LOCAL NAMES AND USES: The usual Fijian name is *uvi*, but also recorded are *uvi ni veikau*, *vutua*, *veiwa*, *sangga*, *sanggua*, *ngelimila*, and *yam*. Several Fijian cultivar names are listed by Seemann, and elsewhere this highest yielding of the cultivated yams is often known as *greater yam*, *water yam*, *winged yam*, *Asiatic yam*, and *white yam*. It is the principal *Dioscorea* used in Fiji, where tubers have been known to reach a length of more than 2 m. and a weight of 45 kilograms; it is principally harvested in March and April.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Mt. Nairoso, eastern flank of Mt. Evans Range, *Smith 4054*; vicinity of Tumbenasolo, valley of Namosi Creek, *Smith 4709*. RA: Mataimavula, vicinity of Rewasa, *Degener 15405*. TAILEVU: Mr. Harness's farm, *DA 7718*. OVALAU: Valley of Mbureta and Lovoni Rivers, *Smith 7499*. VANUA LEVU: MBUA: Southern portion of Seatovo Range, *Smith 1712*. FIJI without further locality, *Seemann 627*.

5. *Dioscorea nummularia* Lam. *Encycl. Méth. Bot.* 3: 231. 1789; Seem. in *Bonplandia* 9: 260. 1861, Viti, 443. 1862, Fl. Vit. 308. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 317. 1892; Merr. *Interpret. Rumph. Herb. Amb.* 148. 1917; Knuth in *Pflanzenr.* 87 (IV. 43): 282. 1924; Guillaumin in *J. Arnold Arb.* 13: 111. 1932; Prain & Burkill in *Ann. Bot. Gard. Calcutta* 14: 367. *pl. 132, 150*. 1939; B. E. V. Parham in *Agr. J. Dept. Agr. Fiji* 13: 40. 1942; Burkill in *Fl. Males. I. 4*: 331. 1951; J. W. Parham, *Pl. Fiji Isl.* 270. 1964, ed. 2. 366. 1972; St. John & A. C. Sm. in *Pacific Sci.* 25: 343. 1971; B. E. V. Parham in *New Zealand Dept. Sci. Indust. Res. Inform. Ser.* 85: 136. 1972.

Dioscorea seemannii Prain & Burkill in J. Asiat. Soc. Bengal, N.S. 10: 34. 1914; Knuth in Pflanzenr. 87 (IV. 43): 272. 1924.

Dioscorea nummularia is thoroughly naturalized in Fiji, occurring from near sea level to 500 m. in forest or on its edges, and in thickets and pastures. It is a scrambling vine with fragrant flowers; the perianth segments are pale green or white. Flowers have been noted from April to June and fruits in October.

TIPIFICATION AND NOMENCLATURE: The whole basis of *Dioscorea nummularia* is *Ubiun nummularium frugiferum* Rumph. Herb. Amb. 5: 444. t. 162. 1747. In the original publication of *D. seemannii* two specimens were cited, both from Fiji without further locality and both at κ : *Seemann* 628 and *Graeffe* s. n. The first may be taken as the lectotype: *Seemann* 628 (κ). No consequential differences separate the two concepts, as realized by Prain and Burkill in their 1939 work.

DISTRIBUTION: This species is presumably a native of southeastern Asia but early attained a wide distribution in the Pacific by aboriginal introductions. In Fiji the species is so thoroughly naturalized as to appear indigenous.

LOCAL NAMES AND USES: *Tivoli* is the commonly used Fijian name, but the species is also known as *rauva*, *rauvida*, *tikau*, and *yam*. The tubers lie deep in the soil and must develop for two or three years to make their harvesting worthwhile. However, they may be baked without other treatment and are considered superior in Fiji to those of other species of *Dioscorea* except *D. alata* and *D. esculenta*.

AVAILABLE COLLECTIONS: VITI LEVU: NAITASIRI: Nawanggambena, *DA* 2399. TAILEVU: Hills east of Wainumbuka River, vicinity of Ndakuivuna, *Smith* 7001; Navunisolo, *DA* 11284 (*Barrau* 637), 11285 (*Barrau* 638); Wainivesi, *DA* 11271. REWA: Suva, *Barrau* 571; Dept. Agriculture Laboratory Garden, *DA* 10967. VITI LEVU without further locality, *Barrau* 575. OVALAU: Hills east of Lovoni Valley, *Smith* 7355. CULTIVATED at Kew from tubers sent from Fiji, *Burkill*, Jan. 1934.

FAMILY 22. TACCACEAE

TACCACEAE Dumort. Anal. Fam. Pl. 57, 58, as *Taccaeae*. 1829.

Essentially glabrous perennial herbs with a subterranean tuber or rhizome; leaves all radical, large, the petiole long, with a sheathing base, the blades simple or deeply lobed; inflorescence umbellate, the peduncle long, the bracts forming an involucre, the inner ones narrower; flowers σ , actinomorphic, the perianth with a short, broad tube and 6 lobes, these biseriate, somewhat corolline, the inner ones usually the longer; stamens 6, inserted on perianth tube, the filaments short, the anthers 2-locular, with a cucullate appendage, dehiscing by longitudinal, introrse slits; ovary inferior, 1-locular, with 3 parietal placentas, the ovules numerous, anatropous, the style short, the stigmas broad, 3-lobed, often petaloid and reflexed; fruit a berry or 3-valved capsule, the seeds numerous, longitudinally ridged, with copious endosperm and minute embryo.

DISTRIBUTION: Two genera and 35–50 species in tropical areas, especially in southeastern Asia; all the species except one belong in the genus *Tacca*.

USEFUL TREATMENTS OF FAMILY: Drenth, E. A revision of the family Taccaceae. *Blumea* 20: 367–406. 1972. Drenth, E. Taccaceae. *Fl. Males.* 1. 7: 806–819. 1976.

1. *TACCA* J.R. & G. Forst. Char. Gen. Pl. 35. 1775, ed. 2. 69. 1776; Seem. *Fl. Vit.* 101. 1866; Limpricht in Pflanzenr. 92 (IV. 42): 13. 1928. Nom. cons.

Characters of the family; leaves in our species deeply lobed; fruit a berry.

TYPE SPECIES: *Tacca pinnatifida* J.R. & G. Forst. (= *T. leontopetaloides* (L.) Kuntze), the only original species.

DISTRIBUTION: As of the genus.

As indicated in my remarks in *Allertonia* 1: 334-337. 1978, I believe that Drenth (1972, 1976, cited above) has interpreted *Tacca leontopetaloides* too broadly. In my opinion two well-marked species occur in Fiji.

KEY TO SPECIES

- Petioles and scapes greenish or greenish-striate, often grooved, the outer bracts of the involucre elliptic, 3-4 cm. broad; leaf blades 40-100 cm. long and broad, the three main segments usually short-petiolulate and pinnate in basal portion, with some segments free to the midrib, the ultimate leaf divisions deltoid or ovate-deltoid, 5-15 cm. long and 2-8 cm. broad, acuminate at apex, the actual tip sharp but not filiform, scarcely curled; occurring primarily on or near beaches. 1. *T. leontopetaloides*
- Petioles and scapes purple- and green-mottled, smooth, the outer bracts of the involucre oblong, 1-1.5 cm. broad; leaf blades 35-50 cm. long and broad, the three main segments merely pinnatifid with blades joined at base and not petiolulate, the ultimate leaf divisions lanceolate, 8-15 cm. long and (0.2-) 1.3-2.5 cm. broad, distally attenuate to a very slender and often filiform, curled tip; occurring primarily in forest away from beaches. 2. *T. maculata*

1. *Tacca leontopetaloides* (L.) Kuntze, Rev. Gen. Pl. 2: 704. 1891; Merr. in J. Arnold Arb. 26: 85. pl. I, II. 1945; Yuncker in Bishop Mus. Bull. 220: 81. 1959; J. W. Parham, Pl. Fiji Isl. 283. 1964, ed. 2. 378. 1972; Sykes in New Zealand Dept. Sci. Indust. Res. Bull. 200: 270. 1970; B. E. V. Parham in New Zealand Dept. Sci. Indust. Res. Inform. Ser. 85: 76. 1972; Drenth in Blumea 20: 375, p. p. 1972; A. C. Sm. in *Allertonia* 1: 335. fig. 1, A, B. 1978.

Leontice leontopetaloides L. Sp. Pl. 313. 1753.

Tacca pinnatifida J. R. & G. Forst. Char. Gen. Pl. 35. t. 35. 1775, ed. 2. 70. t. 35. 1776; Forst. f. Pl. Esc. Ins. Oc. Austr. 59. 1786, Fl. Ins. Austr. Prodr. 36. 1786; Benth. in London J. Bot. 2: 239. 1843; Seem. in Bonplandia 9: 260. 1861, in op. cit. 10: 297. 1862, Viti, 443. 1862, Fl. Vit. 102. 1866, op. cit. 429. 1873; Drake, Ill. Fl. Ins. Mar. Pac. 316. 1892; Limpricht in Pflanzenr. 92 (IV. 42): 27. fig. 5. 1928; Guillaumin in J. Arnold Arb. 13: 110. 1932; Christophersen in Bishop Mus. Bull. 128: 50. 1935; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 13: 42. 1942; Yuncker in Bishop Mus. Bull. 178: 35. 1943, in op. cit. 184: 29. 1945.

In Fiji *Tacca leontopetaloides* is found primarily on beaches, in beach thickets, or in woods near coasts, but occasionally it occurs in forest near the coast up to 250 m. elevation. It is a coarse herb up to 1 m. in height, with leaves and scape arising from irregularly globose to ellipsoid tubers up to 8 cm. in diameter; its bracteoles are deep purple, its perianth segments green, and its anthers dull yellow. It is most often found in flower between November and February and in fruit simultaneously or as late as July.

TYPIFICATION AND NOMENCLATURE: *Leontice leontopetaloides* is based wholly on *Leontopetaloides* Ammann in Comment. Acad. Sci. Imp. Petrop. 8: 211. t. 13. 1741; as the locality Ammann mentioned "India Orientalia," which Merrill (1945, cited above) suggests could mean from any part of Indo-Malesia. *Tacca pinnatifida* is based on J. R. & G. Forster (BM HOLOTYPE; ISOTYPE at K) from Tahiti, Society Islands. As pointed out by Merrill and as accepted by all recent students, there can be no doubt of the conspecific nature of the two names.

DISTRIBUTION: Paleotropical, extending from India and Ceylon eastward through Malesia to Micronesia and extreme eastern Polynesia. It was certainly an aboriginal introduction to Polynesia as a tuberous crop plant, and the eastern limit of its indigeness is problematical; however, it may well have reached Fiji and Samoa without the aid of man. About 25 Fijian collections are available, but the species is more abundant than this would imply.

LOCAL NAMES AND USES: *Yambia* and *yambia ndina* are the usual Fijian names, but the species is also known as *farasiko*, *Fiji arrowroot*, and *Fijian cassava*. Although the untreated tubers are said to be poisonous, they are grated to provide starch which can be soaked and washed to remove bitterness and then baked into small cakes with coconut milk. Seemann gives a very useful account of the genus in *Flora Vitiensis*.

REPRESENTATIVE COLLECTIONS: YASAWAS: WAYA: Olo Creek, north of Yalombi, *St. John* 18028. VITI LEVU: NANDRONGA & NAVOSA: Tonuve, *H. B. R. Parham* 180. SERUA: Coastal strip near Ngaloa, *Smith* 9337. REWA: Nukulau Island, *Barclay* 3429. MBENGGA: Raviravi, *DA* 6075. OVALAU: Port Kinnaird, *Seemann* 633. KORO: *Tothill* 186C. NAIRAI: *Milne* 154. VANUA LEVU: MATHUATA: Wainikoro River, *Greenwood* 696. THAKAUNDROVE: Savusavu Bay area, *Degener & Ordonez* 13996. TAVEUNI: Waiyevo, *DA* 5732. TOTOYA: *Tothill* 186. LAKEMBA: Near Tumbou Jetty, *Garnock-Jones* 771. FULANGA: *Tothill* 186A. FIJI without further locality, *Harvey*, Nov. 1855, *Storck* 908.

2. *Tacca maculata* Seem. Fl. Vit. 103. 1866, op. cit. 429. 1873; Drake, Ill. Fl. Ins. Mar. Pac. 316. 1892; Limpricht in Pflanzenr. 92 (IV. 42): 30. 1928; Merr. in J. Arnold Arb. 26: 91. 1945; J. W. Parham, Pl. Fiji Isl. ed. 2. 378. 1972; A. C. Sm. in Allertonia 1: 335. fig. 1, C, D. 1978.

Tacca sativa sensu Seem. in Bonplandia 9: 260. 1861, in op. cit. 10: 297. 1862, Viti, 443. 1862; non Rumph.

Tacca samoensis Reinecke in Bot. Jahrb. 25: 595. t. IX. 1898.

Tacca pinnatifida subsp. *maculata* Limpr. Beitr. Kennt. Taccac. Diss. 56. 1902.

Tacca pinnatifida var. *maculata* Domin in Biblioth. Bot. 20 (85): 534. 1915.

Tacca maculata, like the related *T. leontopetaloides*, is a coarse herb up to 1 m. in height, but it occurs away from beaches in the dry forest of coastal hills or in open, rolling country, at elevations from near sea level to 350 m. Its perianth segments are green and its styles are also green but purplish distally. Flowers and fruits have been noted between November and April.

LECTOTYPIFICATION AND NOMENCLATURE: *Seemann* 632 (κ), probably from Moturiki, was designated as the lectotype of *Tacca maculata* by me in 1978. The holotype of *T. samoensis* was *Reinecke* 188 (B), collected in December, 1893, on Mt. Vailele, Upolu, Samoa; extant duplicates of this are available, but I refrain from indicating a lectotype, since the original plate clearly indicates its identity with *T. maculata*. In 1978 (cited above) I indicated reasons for separating this taxon from *T. leontopetaloides*.

DISTRIBUTION: Fiji and Samoa; it is apparently less abundant in Samoa than in Fiji, but in both archipelagoes it is less frequent than *T. leontopetaloides*.

LOCAL NAMES AND USES: *Yambia sa* is the usual Fijian name, but also recorded are *yambia*, *marevo*, and *arrowroot*. According to Seemann the Fijians used the tubers as they did those of *Tacca leontopetaloides*.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Vakambuli, inland from Lautoka, *DA* 11148; mountains inland from Lautoka, *Greenwood* 405. SERUA: Coastal hills in vicinity of Taunovo Creek, east of Wainiambia, *Smith* 9598. VANUA LEVU: MATHUATA: Seanggangga Plateau, in drainage of Korovuli River, vicinity of Natua, *Smith* 6742. THAKAUNDROVE: Vunisalusalu, *DA*, April 9, 1948; Maravu, near Salt Lake, *Degener & Ordonez* 14129; hills west of Mbutha Bay, Natewa Peninsula, *Smith* 829. FIJI without further locality, *Milne* 154 bis, *Harvey*, in Nov. 1855, *Storck* 909, *Horne* 598.

FAMILY 23. PONTEDERIACEAE

PONTEDERIACEAE Kunth in H. B. K. Nova Gen. et Sp. 1: 265, as *Pontedereae*. 1816.

Aquatic herbs, the stems erect or floating, with numerous air chambers (like petioles), the leaves with floating or emersed or submersed blades, the petioles

sheathing at base; inflorescence a sympodial cymose pseudoraceme, subtended by 1 or 2 spathe-like leaf sheaths, the bracts minute or absent; flowers ♂, actinomorphic or zygomorphic, the perianth hypogynous, corolline, persistent, the lobes 6, mostly biseriate, separate or partially united, blue or lilac; stamens in our genera 6 (less often in other genera 3, rarely 1), inserted on perianth, sometimes unequal, one often the largest, the filaments free, the anthers 2-locular, dehiscent by lengthwise slits or by pores; ovary superior, 3-locular with axile placentas (in our genera) or 1-locular with 3 parietal placentas, the ovules anatropous, numerous to solitary (and then pendulous), the style long, the stigma entire or shortly lobed; fruit a capsule dehiscent by 3 valves or indehiscent, the seeds longitudinally ribbed, with copious endosperm and a straight, terete embryo.

DISTRIBUTION: Tropics or subtropics, in freshwater, with six or seven genera and about 30 species. Two genera occur in Fiji, but neither is indigenous.

KEY TO GENERA

- Flowers pedicellate; perianth actinomorphic, the segments free, the posterior tepal lacking a discolored blotch; stamens 6, one longer than the others, the filaments glabrous, the anthers basifixed, dehiscent by a pore-like slit. 1. *Monochoria*
- Flowers sessile; perianth zygomorphic, the segments partly connate into a tube, the posterior tepal with a discolored blotch; stamens 6, 3 much longer than the others, the filaments glandular-pilose, the anthers dorsifixed near base, versatile. 2. *Eichhornia*

1. **MONOCHORIA** Presl, Rel. Haenk. 1: 127. 1827; Kunth, Enum. Pl. 4: 132. 1843; Solms in DC. Monogr. Phan. 4: 522. 1883; Schwartz in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. 15a: 186. 1930; Backer in Fl. Males. I. 4: 255. 1951.

Glabrous palustrine herbs, with obliquely erect stems arising from a suberect or creeping rhizome, the leaves radical, long-petiolate; inflorescence racemiform or subumbelliform, the flowers deflexed after anthesis, the 3 inner tepals the broader; 5 stamens with small, yellow anthers, the sixth with a longer filament with a lateral tooth and a larger, blue anther; fruit a loculicidally dehiscent capsule.

TYPE SPECIES: *Monochoria hastata* Presl, nom. illeg. (*Pontederia hastata* L.) = *M. hastata* (L.) Solms.

DISTRIBUTION: Three species from Africa to eastern Asia and Australia; cultivated and adventive elsewhere. Two species have been noted in Fiji.

KEY TO SPECIES

- Rhizome short; leaf blades of adult plants emersed, ovate-oblong to broadly ovate, obtuse or rounded or truncate-cordate at base, 2–12.5 × 0.5–10 cm., the basal lobes if present broadly rounded; flowers 3–25, expanding simultaneously or essentially so; perianth 11–15 mm. long. 1. *M. vaginalis*
- Rhizome well developed, branched; leaf blades of adult plants usually with a sagittate or hastate base, 7–25 × 5–20 cm., the basal lobes divergent; flowers 15–60, not expanding simultaneously; perianth 15–18 mm. long. 2. *M. hastata*

1. ***Monochoria vaginalis*** (Burm. f.) Presl, Rel. Haenk. 1: 128. 1827; Kunth, Enum. Pl. 4: 134. 1843; Solms in DC. Monogr. Phan. 4: 524. 1883; Merr. in Philipp. J. Sci. 19: 343. 1921; Backer in Fl. Males. I. 4: 256. 1951; J. W. Parham, Pl. Fiji Isl. 265. 1964, ed. 2. 358. 1972.

Pontederia vaginalis Burm. f. Fl. Ind. 80. 1768; L. Mant. Pl. Alt. 222. 1771.

Monochoria hastata sensu B. E. V. Parham in Agr. J. Dept. Agr. Fiji 18: 39. 1947; non Presl.

Monochoria hastata sensu Greenwood in J. Arnold Arb. 30: 82. 1949; J. W. Parham in Dept. Agr. Fiji Bull. 35: 143, fig. 72. 1959; non Solms.

In Fiji this species occurs as an adventive, as well as an ornamental, near sea level, although elsewhere it is found up to 1,500 m. or higher. It is often locally abundant in stagnant backwaters of rivers, in open drains, rice fields, swampy

places, ditches, and wet pastures. Its perianth is pale blue, the segments deeper blue or purple distally, and its filaments are also pale blue. Flowers occur at any season.

TYPIFICATION: *Pontederia vaginalis* is based on pre-Linnaean references to Rheede and Plukenet. As indicated in the above synonymy, this species was mistaken for *Monochoria hastata* in Fiji until recently.

DISTRIBUTION: Southeastern Asia to Japan and throughout Malesia; introduced and naturalized elsewhere. About 20 Fijian collections are available; it is probably a fairly recent introduction, as none of the earlier collectors in Fiji obtained it.

LOCAL NAMES AND USE: *Mbekambekairanga*; *pickerel weed*. Although the species is considered an ornamental, its use is discouraged as it readily becomes a naturalized weed.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Sawani, *Vaughan 3163*. SERUA: Navua flats, *Vaughan 3369*; Nakaulevu, *DA 10106*. RA: Mburutu Valley, *DA 9496*. NAITASIRI: Vinindawa, *DA 10016*; Nanduna, *DA 9599*; Koronivia, *DA 10966*. TAILEVU: Vunivaivai, *DA 10569*; Visama, *DA 10589*; Mbua road, near Kuku, *DA 10613*. REWA: Vatuwanga, *DA 6086*. OVALAU: Valley of Mbureta and Lovoni Rivers, *Smith 7669*.

2. *Monochoria hastata* (L.) Solms in DC. Monogr. Phan. **4**: 523. 1883; Backer in Fl. Males. I. **4**: 258, *fig. 1*. 1951; J. W. Parham, Pl. Fiji Isl. ed. 2. 358. 1972.

Pontederia hastata L. Sp. Pl. 288. 1753.

Monochoria hastaeifolia Presl, Rel. Haenk. **1**: 128, nom. illeg. 1827; Kunth, Enum. Pl. **4**: 133. 1843.

In Fiji *Monochoria hastata* is sparsely cultivated and has not become naturalized. Its perianth is pale blue and its filaments white. The only available collection was in flower in January.

TYPIFICATION: Linnaeus gave several prior references and indicated: "*Habitat in India*."

DISTRIBUTION: Southeastern Asia and Malesia; cultivated elsewhere.

USE: Ornamental in water gardens.

AVAILABLE COLLECTION: VITI LEVU: REWA: Suva Botanical Gardens, *DA 12290*.

2. *EICHHORNIA* Kunth, Eichhornia, Genus Novum (Diss.). 1842, Enum. Pl. **4**: 129. 1843; Solms in DC. Monogr. Phan. **4**: 525. 1883; Schwartz in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. **15a**: 185. 1930; Backer in Fl. Males. I. **4**: 259. 1951. Nom. cons.

Floating aquatic herbs, rooting from nodes, the leaves clustered, often long-petiolate, the blades broadly ovoid-rhomboid; inflorescence spiciform, 2-many-flowered, with long peduncles, the perianth zygomorphic; stamens strongly unequal, the 3 anterior ones short, the 3 posterior ones longer, with glandular-pilose filaments.

TYPE SPECIES: *Eichhornia azurea* (Sw.) Kunth (*Pontederia azurea* Sw.). Typ. cons.

DISTRIBUTION: About seven species in the New World from the southeastern United States and the West Indies to Argentina; cultivated and adventive elsewhere.

1. *Eichhornia crassipes* (Mart.) Solms in DC. Monogr. Phan. **4**: 527. 1883; Schwartz in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. **15a**: 186, *fig. 70*. 1930; Greenwood in Proc. Linn. Soc. **154**: 104. 1943; Backer in Fl. Males. I. **4**: 259, *fig. 2, 3*. 1951; Mune & Parham in Agr. J. Dept. Agr. Fiji **25**: 82, *fig.* 1954, in Dept. Agr. Fiji Bull. **31**: 50, *fig. 13; pl. XI-XVI*. 1957; J. W. Parham in op. cit. **35**: 144, *fig. 73, 74*. 1959, Pl. Fiji Isl. 263. 1964, ed. 2. 357. 1972; Mune & Parham in Dept. Agr. Fiji Bull. **48**: 62, *fig. 17*. 1967.

Pontederia crassipes Mart. Nov. Gen. Sp. Pl. 1: 9. t. 4. 1823.

In Fiji this species was considered an ornamental but has now become a locally abundant adventive, occurring near sea level (but elsewhere up to an elevation of 1,600 m. or higher). It is a floating herb with copious fibrous roots, or it may root in mud; it occurs in stagnant or slowly flowing ditches, ponds, drains, streams, rivers, and in rice fields. The perianth segments are blue to blue-violet, the posterior segment with a yellow blotch in its center. Flowers have been noted throughout the year.

TYPIFICATION: The type was collected along the St. Francis River, Minas Gerais or Bahia, Brazil, presumably by Martius.

DISTRIBUTION: A native of Brazil, this species has now become widely naturalized. Although collected only on Viti Levu in Fiji, it is more abundant and perhaps more widespread than the available collections indicate.

LOCAL NAMES AND USE: *Mbekambekairanga*, *ndambendambe ni nga*, *jal khumbe* (Hindi), *water hyacinth*. It was introduced into Fiji about 1905 as an ornamental in water gardens, but its use is discouraged as it has become a naturalized pest and is a declared noxious weed. Chemical weed killers have been effective in clearing streams and rivers in Fiji.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Mba River at Rarawai, *Greenwood 184*. SERUA: Navua, *Vaughan 3161*, *DA 11013*; Tokotoko Road, Navua, *DA 9462*. NAITASIRI: Koronivia, *DA 3991*, *3992*. REWA: Vatuwangga, *DA 6085*. FIJI without further locality, *DA 3481*.

ORDER IRIDALES

FAMILY 24. IRIDACEAE

IRIDACEAE Juss. Gen. Pl. 57, as *Irides*. 1789.

Perennial herbs with underground rhizomes, corms, or bulbs, the stems herbaceous, in groups or solitary; leaves often crowded at base of stem, the blades mostly narrowly linear, flattened at sides, sheathing at base, often distichous or equitant; inflorescence terminal, the flowers borne within floral sheaths, these solitary on stem or combined into simple or branched inflorescences; flowers ♂, actinomorphic or often zygomorphic, the perianth petaloid, with a long or short, straight or curved tube, the segments or lobes 6, biseriate, subequal and similar, or the 2 series different in size, shape, and texture, the dorsal lobe often the largest; stamens 3, opposite the outer perianth segments, the filaments free or partially connate, the anthers 2-locular, opening by extrorse or lateral lengthwise slits; ovary inferior (rarely superior), 3-locular with axile placentas or rarely 1-locular with 3 parietal placentas, the ovules numerous (rarely 1 or few), anatropous, the style slender, 3-branched distally, the branches subulate and entire or deeply lobed, sometimes winged and petaloid; fruit a loculicidally dehiscent capsule, the seeds with copious endosperm and a small embryo.

DISTRIBUTION: A tropical, subtropical, and temperate family, with distributional centers in southern Africa and tropical America. About 60–75 genera and 800–900 species are usually recognized. There are no indigenous species in Fiji, but three genera with cultivated or naturalized species have been recorded there.

In addition to the genera discussed below, it is possible that *Belamcanda*, represented by *B. chinensis* (L.) DC., will be found in cultivation in Fiji, since it so occurs in Tonga (cf. Yuncker in Bishop Mus. Bull. 220: 83. 1959).

KEY TO GENERA

- Flowers pedicellate at anthesis; perianth actinomorphic, the tube very short, the segments similar; inflorescence without imbricate bracts; floral sheaths 2-several-flowered, with the capsules exserted; stem flattened; rhizomatous plants. 1. *Sisyrinchium*
- Flowers sessile; perianth zygomorphic, the tube obvious, gradually tapered from base to apex; stamens more or less together on one side; floral sheaths 1-flowered; tuberous plants.
- Perianth tube (in our species) slightly expanded upward; floral sheaths ovate-oblong; capsule small, ellipsoid. 2. *Tritonia*
- Perianth tube conspicuously expanded upward; floral sheaths somewhat lanceolate; capsule larger, ellipsoid or obovoid. 3. *Gladhiolus*

1. *SISYRINCHIUM* L. Sp. Pl. 954. 1753.

Herbs with fibrous roots or short rhizomes, the leaves with narrow, linear, sword-shaped, or terete blades (not more than 12 cm. long in our species); floral sheaths several-flowered, long-pedunculate; flowers pedicellate, actinomorphic, the segments subequal, connate proximally; filaments usually basally connate; style filiform, with simple branches; capsule globose, not more than 3 mm. in diameter in our species.

TYPE SPECIES: *Sisyrinchium bermudianum* ("bermudiana") L., the only original species.

DISTRIBUTION: About 100 species in America, including the West Indies.

1. *Sisyrinchium micranthum* Cav. Monad. Classis Diss. 6: 345. pl. 191, fig. 2. 1788; A. C. Sm. in Bull. Torrey Bot. Club 70: 535. 1943; Greenwood in J. Arnold Arb. 30: 81. 1949; J. W. Parham, Pl. Fiji Isl. 269. 1964, ed. 2. 365. 1972.

This inconspicuous species is sparsely naturalized in pastures at elevations of 750–800 m. It is a flat-peduncled herb to 15 cm. high, the perianth segments being yellow with brown markings and the capsule globose and small. The only available collection bore fruit in November.

TIPIFICATION: The holotype, presumably collected by Cavanilles in Peru, is in the Jussieu Herbarium at P.

DISTRIBUTION: South America, but now widely distributed and naturalized. It probably was an accidental introduction into Fiji, perhaps mixed with the seeds of some pasture grass.

LOCAL NAME: *Wa ma ndrala*. Greenwood (1949, cited above) indicates that the species is believed to be poisonous to stock in Queensland.

AVAILABLE COLLECTION: VITI LEVU: MBA: Vicinity of Nandarivatu, Gillespie 3728.

2. *TRITONIA* Ker-Gawler in Bot. Mag. 16: sub t. 581. 1802.

Tuberous herbs, the leaves linear-lanceolate; inflorescence composed of 1-flowered floral sheaths combined into a distichous spiciform structure; flowers actinomorphic or (in our species) zygomorphic, the tube curved and distally broadened and the segments unequal (in our species); stamens with filiform filaments; capsule ellipsoid, thin-walled, less than 1 cm. long in our species.

LECTOTYPE SPECIES: *Tritonia squalida* Ker-Gawler, nom. illeg. (*Ixia lancea* Thunb.) = *T. lancea* (Thunb.) N. E. Br. (vide E. P. Phillips, Gen. S. Afr. Fl. Pl. ed. 2. 218. 1951).

DISTRIBUTION: About 55 species in tropical and southern Africa.

1. *Tritonia* × *crocosmiiflora* (Lem. ex André) Nicholson, Ill. Dict. Gard. 4: 94, as *T. crocosmiiflora*. 1887; J. W. Parham, Pl. Fiji Isl. ed. 2. 365. 1972.

Montbretia × *crocosmiaeflora* Lem. ex André in Rev. Hort. 54: 124. pl. 1882.

Tritonia crocosmiaeflora Nicholson ex A. C. Sm. in Bull. Torrey Bot. Club 70: 535. 1943; J. W. Parham, Pl. Fiji Isl. 269. 1964.

This garden hybrid is sparingly cultivated in Fiji and is also naturalized in open, waste places at elevations from near sea level to about 800 m. It is an herb to about 1.5 m. tall, the perianth segments being orange-red without and yellow within with red markings in the throat and orange distally; the stamens, style, and stigmas are dark yellow. Flowers have been noted in February and July, but in cultivation the plant doubtless flowers more often.

TIPIFICATION: In the original description André noted that this hybrid was obtained by crossing *Crocoshia aurea* and *Montbretia pottsii* (i. e. *Tritonia pottsii*).

DISTRIBUTION: This garden plant is widely cultivated; in the Pacific specimens have been noted from New Guinea and Hawaii, where it is also naturalized.

USE: Ornamental.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Nandarivatu and vicinity, *Parks 20658, DA 12541*.

3. GLADIOLUS L. Sp. Pl. 36. 1753.

Tuberous herbs, the leaves with linear or sword-shaped, equitant blades; inflorescence composed of 1-flowered floral sheaths combined into a distichous, unilateral, spiciform structure; perianth zygomorphic, the tube curved and distally conspicuously broadened, the segments unequal, narrowed at base, the 3 posterior ones the broader; stamens inserted in perianth throat, the filaments free, the anthers attached in a broad cleft; style filiform, its branches simple, not petaloid; capsule ellipsoid or obovoid, thin-walled, up to 5 cm. in length.

LECTOTYPE SPECIES: *Gladiolus communis* L. (vide Hitchcock, Prop. Brit. Bot. 118. 1929), one of Linnaeus's six original species.

DISTRIBUTION: About 300 species from Madeira, the Canary Islands, and Europe to central and southwestern Asia and Africa.

1. *Gladiolus* × *hybridus* Hort. ex E. Rodigas in Ill. Hort. 37: 107. t. 115. 1890; J. W. Parham, Pl. Fiji Isl. 269. 1964, ed. 2. 365. 1972.

The large, varicolored flowers make this common garden hybrid popular, although in Fiji it is sparingly grown in the cooler season. No herbarium vouchers are available.

TIPIFICATION: Rodigas indicated the hybrid to have as its parents *Gladiolus* × *gandavensis* and *G. cardinalis*.

DISTRIBUTION: Grown widely in temperate gardens, less often in tropical areas.

USE: Ornamental.

ORDER ZINGIBERALES

The number of families to be recognized as distinct in the order Zingiberales has increased during the past few decades, but there is now such an accumulation of sound anatomical and morphological evidence that most recent botanists are willing to accept eight families as composing the order. All of these are represented in Fiji except the Lowiaceae, but only two of them, Heliconiaceae and Zingiberaceae, have species indigenous in Fiji. The inclusion of the Zingiberales in the subclass Liliidae, as proposed by Takhtajan (1969), is here accepted with considerable diffidence, since Cronquist (1968), Hutchinson (1973), and Thorne (1976) all refer them to an alliance including the Bromeliales and Commelinales (subclass Commelinidae as here utilized). (The parenthetical dates refer to publications listed at the end of the Introduction to this volume.)

USEFUL TREATMENTS OF ORDER: Tomlinson, P.B. Phylogeny of the Scitamineae—morphological and anatomical considerations. *Evolution* **16**: 192–213. 1962. Tomlinson, P.B. Classification of the Zingiberales (Scitamineae) with special reference to anatomical evidence. In: Metcalfe, C.R. (ed.). *Anatomy of the Monocotyledons* **3**: 295–389. 1969.

KEY TO FAMILIES OCCURRING IN FIJI

- Androecium not petaloid; fertile stamens 5, rarely 6, each 2-locular.
 - Ovules numerous in each ovary locule.
 - Leaves and bracts distichously arranged; flowers hermaphrodite, the perianth segments free; stamens 5 or 6; fruit a loculicidally 3-valved capsule, the seeds arillate. 25. STRELITZIACEAE
 - Leaves and bracts spirally arranged; flowers unisexual (very rarely hermaphrodite), with 5 perianth segments united and 1 free; fertile stamens 5, the sixth small and rudimentary; fruit a fleshy, indehiscent, 3-locular berry, the seeds not arillate. 26. MUSACEAE
 - Ovules solitary in each ovary locule; leaves and bracts distichously arranged; flowers hermaphrodite, the perianth segments often partially connate; stamens 5 with linear anthers, the sixth modified into a short, petaloid staminode; fruit a schizocarp, the seeds not arillate. 27. HELICONIACEAE
- Androecium petaloid; fertile stamen 1.
 - Fertile stamen 2-locular, the style protruded between the anther locules.
 - Leaves spirally arranged, the sheaths tubular, closed; lateral staminodes and epigynous glands absent; aromatic oil cells absent. 28. COSTACEAE
 - Leaves distichously arranged, the sheaths open on side opposite lamina; lateral staminodes usually petaloid or represented by teeth at base of labellum, occasionally absent; epigynous glands rarely absent; aromatic oil cells present. 29. ZINGIBERACEAE
 - Fertile stamen with a single functional locule.
 - Petiole without a distal pulvinus; flowers large and showy, the inner perianth segments often yellow to red; ovules numerous in each ovary locule; seeds not arillate. 30. CANNACEAE
 - Petiole with a distal pulvinus; flowers comparatively small, the inner perianth segments and staminodes not conspicuously colored; ovules solitary in each ovary locule; seeds arillate. 31. MARANTACEAE

FAMILY 25. STRELITZIACEAE

STRELITZIACEAE Hutchinson, *Fam. Fl. Pl.* **2**: 72. 1934.

Perennial rhizomatous herbs or small trees of palmlike habit with erect, woody, caespitose trunks; leaves large, rolled in bud, distichous, glabrous, long-petiolate, the blades penninerved; inflorescence terminal or (in our genera) lateral long-pedunculate cincinni enclosed in a large cymbiform bract; flowers large, ♀, the perianth segments 6, free, the outer 3 essentially equal, the 2 lateral segments of the inner series closely apposite, forming a conspicuous sagittate structure, the median inner segment short, cymbiform; stamens 5 or 6, the filaments long, rigid, the anthers basifixed, linear, 2-locular, dehiscing by longitudinal slits; ovary inferior, 3-locular, the ovules numerous, axile, the style slender, rigid, the stigma 3-parted; fruit a woody, loculicidally 3-valved capsule, the seeds numerous, arillate.

DISTRIBUTION: Tropical South America, southern Africa, and Madagascar, composed of three widely separated genera with about seven species.

KEY TO GENERA

- Plants with a true subaerial stem, the leaf bases containing water; flowers slightly zygomorphic; stamens 6; ovules in 2 rows in each ovary locule; style with a thickened, tridentate tip. 1. *Ravenala*
- Plants (our species) with an almost completely suppressed aerial stem; flowers conspicuously zygomorphic; stamens 5; ovules superposed in each ovary locule; style deeply 3-parted. 2. *Strelitzia*

1. *RAVENALA* Adanson, *Fam. Pl.* **2**: 67. 1763; K. Schum. in *Pflanzenr.* **1** (IV. 45): 28. 1900.

Plants palmlike in appearance, with a true subaerial stem (trunk), bearing large 2-ranked leaves crowded into a flabelliform crown; cincinni combined into biseriate inflorescences situated singly in axils of lower leaves, each cincinnus with a large, persistent, basal bract; stamens 6, the anthers longer than filaments; ovules in 2

rows in each ovary locule, the style with a thickened, tridentate tip; capsule oblong-linear, the seeds in 2 opposite rows in each valve of fruit, with a blue, lacinate aril.

TYPE SPECIES: *Ravenala madagascariensis* Sonnerat.

DISTRIBUTION: One species in Madagascar.

1. *Ravenala madagascariensis* Sonnerat, Voy. Ind. Orient. 3: 244. pl. 124-126. 1782; J. F. Gmelin, Syst. Nat. 567. 1791; K. Schum. in Pflanzenr. 1 (IV. 45): 29. fig. 6, 7A-F. 1900; Yuncker in Bishop Mus. Bull. 178: 39. 1943; J. W. Parham in Agr. J. Dept. Agr. Fiji 19: 100. fig. 12. 1948, in op. cit. 29: 33. 1959, Pl. Fiji Isl. 259. 1964, ed. 2. 353. 1972; Sykes in New Zealand Dept. Sci. Indust. Res. Bull. 200: 257. 1970.

In cultivation near sea level only, this striking plant is a simple-stemmed tree with a fan-shaped cluster of leaves at its tip, the trunk to 10 m. tall, the leafsheaths containing water partly from rain and partly excreted by the plant. The leaves have blades as large as 3×1 m. and petioles to 3 m. long. The perianth segments are whitish and the seeds have conspicuous blue arils.

TYPEIFICATION: Although the binomial is often accredited to Gmelin, Sonnerat's prior description and plates are clearly the original usage of the binomial *Ravenala madagascariensis*. Sonnerat also discussed the use of the plant in Madagascar under the generic name only (Voy. Ind. Orient. 2: 318, 322. 1782).

DISTRIBUTION: A native of Madagascar, the species is now widely cultivated as an ornamental curiosity. No herbarium vouchers are available from Fiji, but the species may be seen growing in Suva and perhaps elsewhere.

LOCAL NAMES AND USES: *Travellers' tree* and *travellers' palm* are the widely used vernacular names, as potable water collects in the leafsheaths. It was introduced into Fiji in the 1880's as an ornamental.

2. *STRELITZIA* Ait. Hort. Kew. 1: 285. 1789; K. Schum. in Pflanzenr. 1 (IV. 45): 31. 1900.

Herbaceous plants, our species with almost completely suppressed aerial stems (other species with aerial stems), the leaves crowded into a flabelliform crown; cincinni solitary or combined into a spiciform inflorescence; flowers strongly zygomorphic; stamens 5, equalling the 2 larger inner perianth segments; ovules superposed and uniseriate in each ovary locule, the style long, deeply 3-parted; capsule linear, the seeds with an orange aril.

TYPE SPECIES: *Strelitzia reginae* Ait., the only original species.

DISTRIBUTION: Five species in southern Africa.

1. *Strelitzia reginae* Ait. Hort. Kew. 1: 285. t. 2. 1789; K. Schum. in Pflanzenr. 1 (IV. 45): 31. 1900; J. W. Parham, Pl. Fiji Isl. 259. 1964, ed. 2. 354. 1972.

In cultivation near sea level only, this beautiful plant is an herb with a fanlike leaf arrangement; the inflorescence bracts are green, mauve at the apertures and red at the edges; the perianth segments are orange except for the smallest inner one, which is blue; the seeds are black with orange arils.

TYPEIFICATION: The type was a cultivated plant introduced from the Cape of Good Hope by Banks in 1773. Schumann considers the species composed of several varieties.

DISTRIBUTION: A native of South Africa, the species is now widely cultivated. It is more frequently seen in Fiji than suggested by the single collection here cited.

LOCAL NAMES AND USE: *Bird of paradise plant* and *Strelitzia* are widely used as vernacular names. The species is probably of recent introduction into Fiji as an ornamental.

AVAILABLE COLLECTION: VITI LEVU: REWA: Suva, in private garden, DA 16231.

FAMILY 26. MUSACEAE

MUSACEAE Juss. Gen. Pl. 61, as *Musae*, 1789.

Massive herbs with usually tall, erect, aerial shoots arising from swollen, fleshy corms, these either with axillary suckers (in *Musa*) or monocarpic (in *Ensete*); leaves arranged spirally in the aerial shoots, very large, petiolate, their long overlapping bases forming a stout pseudostem with the terminal inflorescence growing up through its center, the leaf blades rolled in bud, glabrous, penninerved; inflorescence a raceme with collateral flowers, these mostly unisexual, zygomorphic, in nodal clusters in axils of large, brightly colored, spathaceous bracts, the σ flowers within the upper bracts, the φ (or rarely σ) flowers within the lower bracts; perianth segments 6 (5 united and 1 free), both whorls petaloid, the 3 outer segments at first narrowly tubular, soon splitting on 1 side, variously toothed at apex, the 3 inner segments forming a more or less 2-lipped structure mostly connate with the outer segments, often truncate and variously dentate at apex; fertile stamens 5, the sixth small and rudimentary, the filaments of fertile stamens filiform, the anthers basifixed, linear, 2-locular, the locules parallel and contiguous, longitudinally dehiscent; ovary inferior, 3-locular, each locule with numerous ovules on an axile placenta, the style in φ flowers filiform from a thickened base, the stigma lobulate; fruit a fleshy, indehiscent, 3-locular berry, the seeds (absent from cultivated forms) with a thick, hard testa and straight embryo in copious endosperm.

DISTRIBUTION: Palaeotropical; two genera with about 47 species.

USEFUL TREATMENTS OF FAMILY: Simmonds, N. W. *Bananas*. 1959. Simmonds, N. W. *The Evolution of the Bananas*. 1962. Purseglove, J. W. *Musaceae. Tropical Crops: Monocotyledons*, 343–384, 1972.

KEY TO GENERA

Pseudostems, if present, markedly dilated at base; flowers and bracts integral with each other and with the axis, abscission layers lacking; free perianth segment 3-lobed, the other segments separate essentially to base; pollen grains verrucose; seeds comparatively large, 6 mm. or more in diameter.

1. *Ensete*

Pseudostems cylindric, not or slightly dilated at base; flowers and bracts separately inserted on the axis, abscission layers present and usually functional; free perianth segment entire, the other segments not deeply divided; pollen grains with a granular surface; seeds if present comparatively small, 7 mm. or less in diameter.

2. *Musa*

1. ENSETE Horan. Prodr. Monogr. Scitam. 8, 40. t. 4, p. p. 1862.

Characters as indicated in the key.

TYPE SPECIES: *Ensete edule* Horan. (*Musa ensete* J. F. Gmelin).

DISTRIBUTION: Africa, Madagascar, southeastern Asia, and Malesia, perhaps an aboriginal introduction as far eastward as the Solomon Islands and the New Hebrides. There is disagreement as to the number of species, Cheesman having recognized 25 and Simmonds only seven; the latter viewpoint seems more generally accepted.

USEFUL TREATMENTS OF GENUS: Cheesman, E. E. Classification of the bananas. 1. The genus *Ensete* Horan. Kew Bull. 2: 97–106. 1948. Simmonds, N. W. Notes on banana taxonomy. Kew Bull. 14: 198–212 (*Ensete*, 205–212). 1960.

It is not really necessary to include *Ensete* in the present treatment, as there is no record of its presence in Fiji except for the occurrence of seeds in sea drift (cf.

Cheesman in Kew Bull. 2: 102. 1948). These seeds probably drifted from the Solomons or New Hebrides, but it is conceivable that *E. glaucum* was also an aboriginal introduction into Fiji but has not persisted there or at least has not been recorded as currently growing there.

1. *Ensete glaucum* (Roxb.) E. E. Cheesman in Kew Bull. 2: 101. 1948.

Musa glauca Roxb. Hort. Beng. 19, nom. nud. 1814, Pl. Coromandel 3: 96. pl. 300. 1820, Fl. Ind. 2: 490. 1824.

Ensete glaucum (including *E. calospermum* (F. v. Muell.) E. E. Cheesman) is also accepted by Simmonds as distinct from *E. edule* Horan.

TIPIFYICATION: "A native of *Pegu* (Burma); and from thence introduced, by the discover, the Rev. Mr. F. Carey, into the Botanic Garden at *Calcutta* . . ." (from Roxburgh, 1820).

DISTRIBUTION: Widely but sparsely distributed in Burma, Assam (?), Thailand, southwestern China, the Philippine Islands, New Guinea, and Java. It may also occur as far east as the Solomons and New Hebrides.

As mentioned above, this genus and species are here included only because of Cheesman's record of their occurrence in sea drift in Fiji.

2. *MUSA* L. Sp. Pl. 1043. 1753; Seem. Fl. Vit. 288. 1868; K. Schum. in Pflanzenr. 1 (IV. 45): 13. 1900.

Characters of the family; corms with axillary suckers; pseudostem cylindric, not or slightly dilated at base; outer perianth segments and 2 anterior inner perianth segments joined in a tube, the posterior inner perianth segment free; pollen grains with a granular surface; seeds small or lacking.

LECTOTYPE SPECIES: *Musa paradisiaca* L. (vide Adanson, Fam. Pl. 2: 525, 580. 1763), one of Linnaeus's two original species, the other now being referred to *Heliconia*.

DISTRIBUTION: About 40 paleotropical species.

USEFUL TREATMENTS OF GENUS (additional to those listed under the family): MacDaniels, L. H. A study of the fe'i banana and its distribution with reference to Polynesian migrations. Bishop Mus. Bull. 190: 1-56. 1947. Cheesman, E. E. The classification of the bananas. Kew Bull. 2: 97-117. 1948; op. cit. 3: 11-28, 145-157. 1948. 323-328. 1949; op. cit. 4: 23-28, 133-137, 265-272. 1949. 445-452. 1950; op. cit. 5: 27-31, 151-155. 1950. Simmonds, N. W. Notes on banana taxonomy. Kew Bull. 14: 198-212. 1960. For a review of the banana industry in Fiji, see J. W. McPaul in Agr. J. Dept. Agr. Fiji 29: 117-131. 1959; in op. cit. 30: 5-13. 1960.

A satisfactory review of the genus *Musa* in Fiji is scarcely possible, in part because of the total absence from herbaria of vouchers (collectors preferring not to prepare such unwieldy material), and in part because formal Latin nomenclature of the cultivated bananas is confused and even misleading. Frequently the binomial *Musa sapientum* L. is taken to represent the commercial banana that can be eaten raw and *M. paradisiaca* L. as the plantain, usually eaten cooked. Both of these names refer to closely allied triploid interspecific hybrids and have been applied indiscriminately to both wild species and cultivars.

Largely through the work of E. E. Cheesman and N. W. Simmonds it is now realized that the edible cultivars in sect. *Musa* have for the most part been derived from hybrids between *Musa balbisiana* Colla (Mem. Gen. Musa, 56. 1820) and *M. acuminata* Colla (op. cit. 66). Wild, seeded diploid forms of *M. acuminata* (A genome) have their center of diversity in the Malesian area. *Musa balbisiana* (B genome), of which no diploid form with edible or parthenocarpic fruits is known, is widely dis-

tributed from India to the Philippines and New Guinea but is absent from central Malasia. A system of classification based on ploidy and on the relative contributions of the two parent species has been proposed, and Simmonds has suggested that formal Latin nomenclature be abandoned in sect. *Musa* and replaced by a genome nomenclature. An excellent brief summary of the situation is presented by Pursglove (1972, cited above under the family).

Nevertheless, taxonomists may not be inclined to adopt such a system, and here-with I have attempted to apply Latin nomenclature to the four species of *Musa* occurring in Fiji, based in part on the treatments of Kuntze (Rev. Gen. Pl. 2: 692. 1891) and Barrau (in Bishop Mus. Bull. 223: 48-51. 1961). It should not be expected that a true picture of the relationships of the cultivated bananas is here reflected. The number of forms of *Musa*, some of which are claimed to be "wild," recognized by native peoples in the Pacific (perhaps more in Samoa, Tonga, and eastern Polynesia than in Fiji) is staggering, and I doubt if a lifetime of study by a specializing ethnobotanist will clarify their status.

KEY TO SPECIES

Bracts more or less sulcate, often glaucous, usually strongly revolute on fading; inflorescence pendent or semipendent from the first (sect. *Musa*).

Pseudostems commonly exceeding 3 m. in height. 1. *M. × paradisiaca*

Pseudostems usually 1-2 m. high. 2. *M. nana*

Bracts plane, rarely or never glaucous, not or only slightly revolute on fading (sect. *Australimusa*).

Bunches of fruit lax. 3. *M. textilis*

Bunches of fruit erect. 4. *M. troglodytarum*

1. *Musa × paradisiaca* L. Sp. Pl. 1043. 1753 (*M. balbisiana* Colla × *M. acuminata* Colla).

For practical purposes this binomial is usually used for the cultivated bananas with comparatively tall pseudostems and large fruits (often 15-30 cm. long at maturity).

KEY TO SUBSPECIES

The plantain, with a hard, seedless fruit usually requiring cooking before being eaten.

1a. subsp. *paradisiaca*

The common cultivated seedless banana, with edible raw fruit. 1b. subsp. *sapientum*

1a. *Musa × paradisiaca* L. subsp. *paradisiaca*.

Musa paradisiaca L. Sp. Pl. 1043. 1753; Seem. Fl. Vit. 290. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 315. 1892; K. Schum. in Pflanzenz. 1 (IV. 45): 19, fig. 3. 1900; Yuncker in Bishop Mus. Bull. 178: 38. 1943, in op. cit. 184: 29. 1945; Cheesman in Kew Bull. 3: 145. 1948.

Musa sapientum subsp. *paradisiaca* Baker in Ann. Bot. 7: 213. 1893.

Musa balbisiana sensu J. W. Parham, Pl. Fiji Isl. 258. 1964, ed. 2. 352. 1972; non Colla (1820) nec Cheesman (1948).

TYPIFICATION: Pursglove suggests that *Musa paradisiaca* was based on cv. 'French Plantain' (AAB genome group). It is by no means certain, however, that all the binomials listed above belong to this genome group.

DISTRIBUTION: Various cultivars of "plantains" have been aboriginal introductions from the Indo-Malesian area to all parts of the tropical and subtropical world.

LOCAL NAMES AND USES: *Plantain*; *vundi*; *vundi ndina*. The fruit is comparatively short and thick and is most commonly eaten after boiling. This type of banana is commonly cultivated near Fijian villages.

1b. *Musa* × *paradisiaca* subsp. *sapientum* (L.) K. Schum. in Pflanzenr. **1** (IV. 45): 20. fig. 4, 5. 1900; Christophersen in Bishop Mus. Bull. **128**: 55. 1935; Yuncker in op. cit. **220**: 84. 1959; B.E.V. Parham in New Zealand Dept. Sci. Indust. Res. Inform. Ser. **85**: 27. 1972.

Musa sapientum L. Syst. Nat. ed. 10. 1303. 1759; Seem. Fl. Vit. 289. 1868; Cheesman in Kew Bull. **3**: 145. 1948.

Musa paradisiaca var. *sapientum* Kuntze, Rev. Gen. Pl. 2: 692. 1891.

Musa nana sensu J. W. Parham, Pl. Fiji Isl. 259. 1964, ed. 2. 353. 1972; non Lour.

TYPEIFICATION: Purseglove suggests that *Musa sapientum* was based on cv. 'Silk Fig' (AAB genome group). It is quite possible that the Latin trinomial is inaccurately applied to it. It is more probably a member of the AAA genome group, possibly of the clone 'Gros Michel.'

DISTRIBUTION: Various cultivars of "true bananas" have also been introduced throughout the tropical and subtropical parts of the world, although presumably more recently than those of "plantains."

LOCAL NAMES AND USES: *Banana*; *vundi ni vavalangi*; *veimana*. This taxon, whatever its correct Latin name, is the well-known banana of commerce. It is extensively cultivated in and exported from Fiji.

INADEQUATELY UNDERSTOOD FORMS OF *MUSA PARADISIACA*

In addition to the two subspecies treated above, two others have been discussed as occurring in Samoa and Tonga, and perhaps the names are also in Fijian references.

Musa paradisiaca subsp. *seminifera* (Lour.) K. Schum. in Pflanzenr. **1** (IV. 45): 21. 1900; Merr. in Trans. Amer. Philos. Soc. n. s. **24** (2): 115. 1935; Christophersen in Bishop Mus. Bull. **128**: 54. 1935.

Musa semifera Lour. Fl. Cochinch. 644. 1790.

Musa sapientum var. *seminifera* Baker in Ann. Bot. **7**: 213. 1893.

TYPEIFICATION: (from Merrill, 1935) One of the three species of the common edible banana accepted at the specific rank by Loureiro. They are so briefly characterized as to be recognized only by their listed native names, but *Musa semifera* is taken as the seeded form.

DISTRIBUTION: Christophersen discusses this plant as the wild, seeded, Samoan banana. It is certainly not native in the Pacific but may be an aboriginal introduction. Conceivably Loureiro's species is *Musa balbisiana* Colla or a relative.

Musa paradisiaca subsp. *normalis* (Kuntze) K. Schum. in Pflanzenr. **1** (IV. 45): 20. 1900; Yuncker in Bishop Mus. Bull. **220**: 84. 1959; B.E.V. Parham in New Zealand Dept. Sci. Indust. Res. Inform. Ser. **85**: 27. 1972.

Musa paradisiaca var. *normalis* Kuntze, Rev. Gen. Pl. 2: 692. 1891; Cheesman in Kew Bull. **3**: 150. 1948.

TYPEIFICATION: No type was cited, but Kuntze described this as the variety of *Musa paradisiaca* with seedless, hard fruit pulp, requiring cooking to be edible. His reference to "var. *culta* S. Kurz" as a synonym has not been located.

DISTRIBUTION: From the various discussions I fail to see why this "subspecies" should not be referred to subsp. *paradisiaca*.

2. *Musa nana* Lour. Fl. Cochinch. 644. 1790; K. Schum. in Pflanzenr. **1** (IV. 45): 19. 1900; Merr. in Trans. Amer. Philos. Soc. n. s. **24** (2): 115. 1935; Yuncker in Bishop Mus. Bull. **178**: 37. 1943, in op. cit. **220**: 84. 1959; Sykes in New Zealand Dept. Sci. Indust. Res. Bull. **200**: 256. 1970; B. E. V. Parham in New Zealand Dept. Sci. Indust. Res. Inform. Ser. **85**: 25. 1972.

Musa cavendishii Lamb. in Paxton's Mag. Bot. **3**: 51. pl. & fig. 1. 1837; Seem. Fl. Vit. 289. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 315. 1892; K. Schum. in Pflanzenr. **1** (IV. 45): 17. fig. 1. A-F. 1900; Christophersen in Bishop Mus. Bull. **128**: 56. 1935.

Musa nana is presumably a triploid cultivar of *M. acuminata* Colla, of the AAA genome group. A member of the "Cavendish Subgroup" of Purseglove (1972), the clone grown in Fiji is presumably "Dwarf Cavendish." It is readily distinguished from the plant here referred to *M. paradisiaca* subsp. *sapientum* (which may be an incorrect name for the larger commercial banana) by its short pseudostems and short fruits.

TIPIFICATION AND NOMENCLATURE: Loureiro's specimens were from Indo-China; this is the dwarf form extensively cultivated as the "Chinese banana." The type of *Musa cavendishii* was a cultivated plant, said to be a native of China but sent to England from Mauritius by Charles Telfair in 1829, to Mr. Barclay of Burryhill. Curiously, although the synonymy of the two taxa is unquestionable and was pointed out by Merrill (1935, cited above), the epithet *cavendishii* remains in wide use, perhaps because the name "Cavendish banana" is so firmly entrenched in commercial usage.

DISTRIBUTION: This cultivar would seem to have been a comparatively recent (not an aboriginal) introduction into the Pacific, having been taken from England to Samoa by the missionary John Williams, according to Purseglove.

LOCAL NAMES AND USE: *Chinese banana*; *Jaina leka*; *Cavendish* or *dwarf Cavendish banana*. Although *Musa nana* bears a fruit of good quality which may be eaten raw, it is probably of minor significance in the export trade in Fiji.

3. *Musa textilis* Née in Anales Ci. Nat. **4**: 123. 1801; K. Schum. in Pflanzenr. **1** (IV. 45): 19. 1900; Cheesman in Kew Bull. **4**: 269. 1949; J. W. Parham, Pl. Fiji Isl. 259. 1964, ed. 2. 353. 1972; B. E. V. Parham in New Zealand Dept. Sci. Indust. Res. Inform. Ser. **85**: 25. 1972.

The strongest and most resilient of the hard fibers is obtained from the outer sheaths of the leaf petioles forming the pseudostem of this species; its mature fruits are thick-skinned and inedible.

TIPIFICATION: I have not located information about the tipification of this species, which was doubtless based on a plant from the Philippine Islands.

DISTRIBUTION: It is usually stated that *Musa textilis* occurs wild in the Philippines, but the point is not certain. A great complex of cultivars occurs in the Philippines, and the species is now commercially grown in many other areas.

LOCAL NAMES AND USES: *Manila hemp*; *abacá*. It was introduced into Fiji in the 1880's and many times since, but it is not successfully grown there on a commercial scale. The fiber is very widely used in making ropes, twines, hammocks, hats, mats, etc.

4. *Musa troglodytarum* L. Sp. Pl. ed. 2. 1478. 1763; Seem. in Bonplandia **9**: 260. 1861, Viti, 443. 1862, Fl. Vit. 290, pro syn. 1868; MacDaniels in Bishop Mus. Bull. **190**: 20. 1947.

Musa fehi Bert. ex Vieill. in Ann. Sci. Nat. Bot. IV. 16: 45. 1862; Baker in Ann. Bot. 7: 218. 1893; K. Schum. in Pflanzenz. 1 (IV. 45): 19. 1900; Christophersen in Bishop Mus. Bull. 128: 57. 1935; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 13: 47. 1942; Cheesman in Kew Bull. 4: 445. 1950; J. W. Parham, Pl. Fiji Isl. 259. 1964, ed. 2. 353. 1972; B. E. V. Parham in New Zealand Dept. Sci. Indust. Res. Inform. Ser. 85: 112. 1972.

Musa uranoscopus sensu Seem. Fl. Vit. 290. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 315. 1892; non *M. uranoscopus* Lour.

Musa seemanni F. v. Muell. Fragm. Phyt. Austral. 9: 190, nom. nud. 1875, in Gard. Chron. III. 8: 182. fig. 28. 1890.

Musa sapientum subsp. *trogodytarum* Baker in Ann. Bot. 7: 214. 1893.

The so-called "fe'i banana" has an erect fruiting bunch which contains a red sap; the skin of the parthenocarpic fruit is orange when ripe and the flesh is yellow.

TYPEIFICATION AND NOMENCLATURE: *Musa troglodytarum* is typified by *Musa uranoscopus* Rumph. Herb. Amb. 5: 137. t. 61, fig. 2. 1747. *Musa fehi*, said to grow spontaneously in the mountains of New Caledonia, is presumably typified by a Vieillard collection. F. v. Mueller, in 1875, proposed the name *Musa seemanni* (without a description) to replace *M. uranoscopus* (sic) sensu Seem. In 1890 Mueller published a photograph by Thurston showing (as the text discusses) erectly borne fruits. The type of the name thus validated must be taken as *Seemann 619* (HOLOTYPE presumably at κ), said by Seemann to occur in woods on Viti Levu and Taveuni and to be occasionally cultivated; however, I have been unable to locate any Seemann collections of *Musa*, and it is possible that no specimen was preserved. Seemann had (correctly) referred his plant to *Musa "uranoscopus"* Rumph. That pre-Linnaean name is not to be confused with *Musa uranoscopus* Lour. (1790), which is not based on the Rumphian plate and which should be taken to replace the ornamental species *M. coccinea* Andrews (of sect. *Callimusa*), according to Merrill (in Trans. Amer. Philos. Soc. n. s. 24 (2): 116. 1935).

Cheesman, in 1950, claimed that *Musa troglodytarum* L. is imperfectly understood, although no doubt closely allied to *M. fehi*, which name he and many others have continued to use for this taxon. However, MacDaniels, in his detailed 1947 study of the fe'i banana, accepted the Linnaean name, and this is doubtless the correct solution.

DISTRIBUTION: Although *Musa troglodytarum* is often stated to be indigenous in the Fijian Region and in Polynesia, it is related to *M. maclayi* F. v. Muell., of New Guinea and the Solomon Islands. It is definitely not "wild" farther to the east but is an aboriginal introduction. The fruits, which are edible after being cooked, are still utilized in Tahiti and doubtless elsewhere in Polynesia. The species is certainly infrequent, if indeed still persisting, in Fiji.

LOCAL NAME: *Soangga*.

FAMILY 27. HELICONIACEAE

HELICONIACEAE Nakai in J. Jap. Bot. 17: 201. 1941.

Large, herbaceous perennials with sympodially branched rhizomes, the erect leafy shoots with alternate leaves with overlapping bases forming a pseudostem, each leaf with a long, eligulate, open sheath and a long or short, terete petiole, the lamina rolled in bud; inflorescence terminal on leafy shoots, with distichous or sub-distichous or spirally arranged, spathaceous, colored bracts bearing many-flowered cincinni; flowers ♀, with an inverted symmetry, the outer 3 perianth segments unequal, the posticous one large and free, the remaining 5 perianth segments smaller, often partially connate into a 5-toothed cymbiform structure; stamens 5 with linear

anthers, the sixth modified into a short, petaloid staminode opposite the posticous perianth segment; ovary inferior, 3-locular, the ovules solitary and basal in each locule, the style filiform, the stigma clavate or capitate, 3-lobed; fruit a schizocarp, eventually drying but not dehiscing, the seeds exarillate.

DISTRIBUTION: A single genus with probably 200–250 species, many of which remain to be described, mostly in tropical America but also in Malesia and Melanesia and eastward to Samoa; widely cultivated elsewhere.

Heliconia is sometimes included in the Strelitziaceae, but the only morphological support for this position lies in the fact that the inflorescences consist of cincinni in the axils of spathaceous bracts and in the presence of five stamens. However, *Heliconia* is never arborescent; its flower has an inverted symmetry probably associated with its mode of pollination; its fruit is schizocarpic; its ovules are solitary; and its seeds lack arils. In fact, *Heliconia* may be closer anatomically to Musaceae than Strelitziaceae (Tomlinson in *Evolution* 16: 200. 1962), but it very logically merits placement in its own family. For suggestions as to the correct nomenclature of the species cultivated in Fiji I am indebted to Gilbert S. Daniels.

1. *HELICONIA* L. Mant. Pl. Alt. 147, 211. 1771; K. Schum. in *Pflanzenr.* 1 (IV. 45): 33. 1900. Nom. cons.

Characters and distribution of the family.

TYPE SPECIES: *Heliconia bihai* (L.) L. (*Musa bihai* L.). The rejected generic name is *Bihai* Mill. Gard. Dict. Abridg. ed. 4. 1754.

Heliconia is taxonomically an extremely difficult genus, so attractive that many species are widely cultivated but often grown under incorrect names. Studies now in progress will doubtless clarify the picture, but at the moment many applications of species names should be viewed with suspicion. Characters of the growing plant are important and are often obfuscated in herbarium material. The genus is so overwhelmingly neotropical in distribution that the Old World taxa, in my opinion, have been taxonomically neglected. P. S. Green (in *Kew Bull.* 23: 471–478. 1969) has attempted to rectify this situation, but it appears to me that to recognize only a single species in the Old World, *H. indica* Lam., is not an adequate solution. At least, I have recently (in *Allertonia* 1: 337–341. 1978) indicated fruit and seed characters that seem amply to separate *H. paka*, of Fiji and Samoa, from *H. indica*. The latter species seems very broadly interpreted by Green, and I believe that further field studies are required, especially in the Solomon Islands, the New Hebrides, and New Caledonia, before the true limits of *H. indica* may be stated.

Only one species of *Heliconia* is indigenous in Fiji, and I here also record four cultivated species that are represented by herbarium vouchers. Almost certainly there are other species of the genus cultivated in Fijian gardens for which no material is available.

KEY TO SPECIES

Inflorescence erect; spathaceous bracts distichous, the inflorescence flattened essentially into a single plane.

Leaf blades green.

Plants comparatively small, rarely exceeding 2 m. in height; cultivated species.

Leaves 3–6 per plant, obviously petiolate; spathaceous bracts orange, the perianth orange, green-tipped; plants slender, usually 0.6–1.3 m. in height. 1. *H. psittacorum*

Leaves more numerous, often 10 or more per plant, comparatively short-petiolate; spathaceous bracts red with green distal margins, the perianth white, green-tipped; plants coarser, usually 1.5–2 m. in height. 2. *H. humilis*

Plants comparatively large, (1.5–) 2–6 m. high; spathaceous bracts red, the inner bracts yellowish; fruits usually 20–28 × 15–20 mm.; seeds usually 17.5–24.5 × 8–10 mm. and narrowed at base and apex, laterally flattened and usually with a distinct dorsal keel, deeply rugulose-tuberculate, the hilum with a conspicuous oval cavity 3–5 mm. long; indigenous species. . . . 3. *H. paka*

Leaf blades bronze-colored beneath; spathaceous bracts and perianth bronze, with a red tinge; coarse herbs about 2 m. in height; cultivated species. 4. *H. illustris*

Inflorescence pendulous when flowering; spathaceous bracts red and yellow, not strictly distichous; perianth white, with a yellow-green tinge distally; cultivated species. 5. *H. rostrata*

1. *Heliconia psittacorum* L. f. Suppl. Pl. 158. 1781.

Heliconia humilis sensu J. W. Parham, Pl. Fiji Isl. ed. 2. 353. 1972; non Jacq.

This comparatively small (for the genus), coarse herb is grown from near sea level to about 250 m. It rarely exceeds 1.3 m. in height and has orange bracts; the perianth segments are orange, with green tips.

TIPIFICATION: The original description was based on material collected in Surinam.

DISTRIBUTION: Northern South America (Bahia, Brazil, to Venezuela); very extensively cultivated in other tropical areas.

USE: Ornamental; the species is an attractive addition to borders and is moderately common in Suva gardens.

AVAILABLE COLLECTION: VITI LEVU: NAITASIRI: Toninaiwau, Tholo-i-suva, DA 16710.

In I. E. Lane's key to the species of *Heliconia* commonly grown in Hawaii (in Neal, Gard. Haw. 243–245. 1965), *H. psittacorum* is placed in the synonymy of *H. humilis*, the following species in the present treatment. The two are quite distinct and both are abundantly cultivated in Hawaii and elsewhere.

2. *Heliconia humilis* (Aubl.) Jacq. Pl. Rar. Hort. Schoenbr. 1: 23. t. 48, 49. 1797; K. Schum. in Pflanzenz. 1 (IV. 45); 36. 1900; J. W. Parham, Pl. Fiji Isl. 259. 1964.

Musa humilis Aubl. Hist. Pl. Guiane Fr. 2: 931. 1775.

Heliconia bihai sensu J. W. Parham in Agr. J. Dept. Agr. Fiji 29: 32. 1959; non L.

A coarse, red-bracted herb usually 1.5–2 m. in height, grown in gardens near sea level; its bracts have green margins distally, and its perianth segments are white, with green tips.

TIPIFICATION: The original material, presumably collected by Aublet, came from savannas in French Guiana and Cayenne Island.

DISTRIBUTION: Northern South America; extensively cultivated elsewhere.

LOCAL NAME AND USE: *Crab's claw*. Ornamental; more frequent in the vicinity of Suva than indicated by the sole available collection. Specimens of this species were growing in the Suva Botanical Gardens in 1959, but no voucher for this record has been seen.

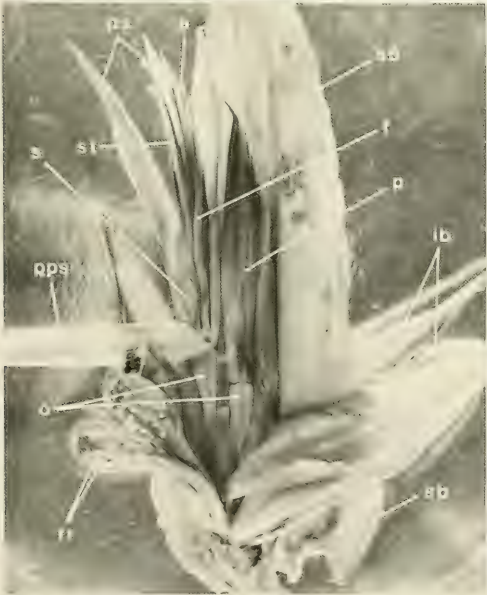
AVAILABLE COLLECTION: VITI LEVU: REWA: Suva, in private garden, DA 16227.

3. *Heliconia paka* A. C. Sm. in Contr. U.S. Nat. Herb. 37: 69. 1967, in Allertonia 1: 340. fig. 3. 1978.

FIGURE 51.

Heliconia bihai sensu Christophersen in Bishop Mus. Bull. 128: 54. 1935; A. C. Sm. in Sargentia 1: 7. 1942; J. W. Parham, Pl. Fiji Isl. 259. 1964; non L.

FIGURE 51. *Heliconia paka*: A, basal portion of inflorescence, × 1/4; B, apical portion of inflorescence, × 1/4; C, opened spathaceous bract bearing a cincinnus, × 1, showing spathaceous bract (sb), inner bracts (ib), ovaries (o), a closed perianth (p), posticous perianth segment (pps), tips of other perianth segments (ps), a filament (f), anthers (a), staminode (s), style (st), and developing fruits (fr); D, seed, lateral view, × 4; A–C from Smith 8900, D from Smith 193.



Heliconia indica Lam. var. *indica*; P.S. Green in Kew Bull. 23: 473, p. p., quoad spec. vit. et sam. 1969; sensu J. W. Parham, Pl. Fiji Isl. ed. 2. 353. 1972; sensu B. E. V. Parham in New Zealand Dept. Sci. Indust. Res. Inform. Ser. 85: 55. 1972.

The only indigenous Fijian *Heliconia* is a coarse herb 1.5–6 m. high, found at elevations from near sea level to 1,000 m. in dense forest or wet thickets, sometimes being locally abundant. The outer bracts are red and the inner bracts dull yellow; the fruit is yellow, becoming orange at maturity. Flowering and fruiting material may be expected throughout the year.

TYPIFICATION: The holotype is *Smith 8900* (US 2191516–2191519 incl.), collected Oct. 15, 1953, in the hills east of the Wainikoroiluva River, near Namuamua, Namosi Province, Viti Levu.

DISTRIBUTION: Fiji and Samoa.

LOCAL NAMES AND USES: The name in common use in Fiji is *paka* (possibly sometimes *papa*), but also noted are *vava*, *vava ni Viti*, and *mboiamboia*. The large leaves are used in the construction of temporary shelters. The seeds are said to be edible when cooked, and the flowers may be eaten raw or boiled.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Vicinity of Nandarivatu, *Degener 14352*; Mt. Tomanivi, *DA 12775* (*Melville et al. 7167*). NAITASIRI: Wainamo–Wainisavulevu divide, Wainimala Valley, *St. John 18263*; Sawani–Serea road, *DA 11295*; Tholo-i-suva, *DA 10652*; Central Road, *Tothill 501, 888, MacDaniels 1152*; Suva Pumping Station, *Degener & Ordenez 13988*. TAILEVU: Vungalei, near Waisere Creek, *DA 2685*. REWA: Near Botanical Station (present Suva Botanical Gardens), *Yeoward, Feb. 22, 1897*. KANDAVU: Hills above Namalata and Ngaloa Bays, *Smith 193*. VANUA LEVU: THAKAUNDROVE: Mt. Vatunivumonde, Savusavu Bay region, *Degener & Ordenez 14011*. TAVEUNI: Nathaungai, *DA L.9864*; track to lake east of Somosomo, *DA L.9866*.

4. *Heliconia illustris* Hort. ex Bull in Gard. Chron. III. 13: 413. 1893.

Heliconia metallica sensu J. W. Parham in Agr. J. Dept. Agr. Fiji 29: 32. 1959, Pl. Fiji Isl. 259. 1964; non Pl. & Linden.

Heliconia acuminata sensu J. W. Parham, Pl. Fiji Isl. ed. 2. 353. 1972; non L. C. Rich.

The cultivated species of *Heliconia* with leaf blades bronze-colored beneath is a coarse herb 1.5–2 m. high, sparingly grown in Fiji from near sea level to about 250 m. Its spathaceous bracts are bronze with a red tinge, as are its perianth segments.

TYPIFICATION: This species was based on a plant known only in cultivation.

DISTRIBUTION: Its original locality uncertain, this taxon is now widely cultivated for its attractive, bronze-colored leaves. Unfortunately, none of the *Heliconiae* with colored leaves are adequately described botanically or backed up by a type. The problem of the *Heliconiae* grown for their decorative leaves can probably be solved only if and when specimens of them can be found in the wild. P.S. Green (in Kew Bull. 23: 477. 1969) considers this and many other forms to be cultivars rather than wild species, but more study is required to establish their relationships.

LOCAL NAME AND USE: *Bronze-leaved Heliconia*; ornamental.

AVAILABLE COLLECTION: VITI LEVU: NAITASIRI: Toninaiwau, Tholo-i-suva, *DA 16725*. Specimens were growing in the Suva Botanical Gardens in 1959, but no voucher for them is at hand.

5. *Heliconia rostrata* Ruiz & Pavon, Fl. Per. Chil. 3: 71. t. 305. 1802; K. Schum. in Pflanz. 1 (IV. 45): 36. 1900; J. W. Parham, Pl. Fiji Isl. ed. 2. 353. 1972.

The large *Heliconia* with green leaves and a strictly pendulous inflorescence is moderately common in gardens in and near Suva (although only one herbarium voucher is available). It attains a height of at least 2 m. and has strongly reflexed, red and yellow spathaceous bracts; its perianth is white, tinged with yellow-green distally.

TIPIFICATION: The species was mentioned by Ruiz and Pavon from several localities in the Peruvian Andes, but it is now widespread in cultivation.

LOCAL NAME AND USE: *Hanging Heliconia*; ornamental.

AVAILABLE COLLECTION: VITI LEVU: NAITASIRI: Toninaiwau, Tholo-i-Suva, DA 16708.

FAMILY 28. COSTACEAE

COSTACEAE Nakai in J. Jap. Bot. 17: 203. 1941.

Usually robust, herbaceous perennials, lacking aromatic oil cells, with sympodially branched, tuberous rhizomes, the aerial shoots often well developed, rarely reduced, the stems often rigid and commonly branched; leaves inserted in a low spiral, the sheaths tubular, closed; inflorescence spicate, cylindric, with an unbranched axis, usually terminal on leafy stems and surrounded at base by often reduced cauline leaves, with usually numerous imbricate primary bracts bearing axillary secondary bracts, these subtending 1 or 2 flowers; flowers ♂, zygomorphic, with 6 perianth segments, the outer 3 united, with often unequal lobes, the inner 3 corolline, subequal; androecium with a single fertile stamen derived from the posticous member of an inner whorl, the other 2 members of this whorl united to form a petaloid labellum, the stamen large, petaloid, exerted from the funnel of the labellum, the anther locules narrow, often apically appendiculate, the lateral staminodes lacking; ovary inferior, 3- or 2-locular, the placentas axile, the ovules numerous, 1- or 2-seriate, the style terminal, protruding between the anther lobes of the fertile stamen, the epigynous glands immersed in ovarian tissue; fruit a partially loculicidally dehiscent capsule, the seeds agglutinated into a mass by means of their fleshy arils.

DISTRIBUTION: Four tropical genera with about 200 species, centering in America.

Although often included in the Zingiberaceae as a tribe or subfamily, the Costaceae appear to merit familial status on the basis of (1) the presence of a true aerial stem rather than a pseudostem composed of overlapping leaf bases, (2) their spiralled leaves with tubular, closed sheaths enclosing the stem, and (3) the absence of aromatic oil cells. Other anatomical differences are also notable (cf. Tomlinson in Metcalfe, *Anatomy of the Monocotyledons* 3: 360-364).

1. *COSTUS* L. Sp. Pl. 2. 1753; K. Schum. in Pflanzenr. 20 (IV. 46): 378. 1904; Holttum in Gard. Bull. Singapore 13: 240. 1950.

Characters of the family; perianth segments comparatively small; labellum large; ovary 3-locular.

TYPE SPECIES: *Costus arabicus* L., the only original species. In spite of the epithet, this species was described from a Surinam plant; it must be typified by Linnaeus's description (cf. Burt & R. M. Sm. in Notes Roy. Bot. Gard. Edinburgh 31: 185. 1972).

DISTRIBUTION: Pantropical, with about 150 species. The other genera of the family are restricted either to America or the Malesia-Queensland area. One species occurs in Fiji in cultivation and naturalized.

1. *Costus speciosus* (König) Sm. in Trans. Linn. Soc. 1: 249. 1791; K. Schum. in Pflanzenr. 20 (IV. 46): 398. 1904; Holttum in Gard. Bull. Singapore 13: 242. 1950; P. M. J. Maas in Fl. Neotropica 8: 121. 1972; J. W. Parham, Pl. Fiji Isl. ed. 2. 355. 1972; Burt & R. M. Sm. in Notes Roy. Bot. Gard. Edinburgh 31: 200. 1972.

Banksea speciosa König in Retz. Obs. Bot. 3: 75. 1783.

The only species of *Costus* in Fiji, originally cultivated but now also locally naturalized, is a coarse herb 1-4 m. high, sometimes found in dense forest from near sea level to about 300 m. Its ovoid inflorescence is 5-10 cm. long, with bracts green to red or red-purple; the outer perianth segments are purplish, the inner ones white and sometimes pink-tinged; the labellum is white with a yellow center and 5 cm. long or more; the filament is white, yellowish at base; and the fruit is bright red. Flowers have been noted from March to May.

TYPEIFICATION: König's species is based on a plant from Malacca, but no specimen is extant (cf. Burt & R. M. Sm., 1972, cited above).

DISTRIBUTION: Indo-Malesia from the Himalayas to New Guinea, but widely cultivated and sometimes naturalized elsewhere.

LOCAL NAMES AND USE: No names have been noted in use in Fiji, but elsewhere this species is known as *cape ginger* or *Malay ginger*. It was introduced into Fiji as an ornamental, probably comparatively recently.

AVAILABLE COLLECTIONS: VITI LEVU: NAITASIRI: Mbatiki-Nanduruloulou, DA 11748. REWA: Mt. Korombamba, DA 3176, 16530; Lami, in private garden, DA 16793; By-Pass road, Suva, DA 11306.

This attractive species is probably more frequent in gardens in and near Suva than suggested above. On the slopes of Mt. Korombamba it is so thoroughly naturalized as to appear indigenous, but it has not been noted in other forested areas.

FAMILY 29. ZINGIBERACEAE

ZINGIBERACEAE Lindl. Key Struct. Phys. Syst. Bot. 69. 1835.

Perennial herbs with aromatic oil cells, usually with thick, fleshy, sympodially branched rhizomes covered with distichous scale leaves; erect vegetative shoots unbranched and usually inconspicuous; aerial shoots mostly formed by overlapping leaf bases constituting a pseudostem, usually terminating in an inflorescence, or the inflorescence and foliage leaves on separate shoots; leaves entire, 2-ranked, rolled in bud, with open sheaths with opposite margins overlapping and ending distally in a ligule, the petiole distinct or essentially none; inflorescence a raceme, head, or paniculiform cyme, often with sheathing bracteoles bearing a lateral axis (cincinnus); flowers mostly ♂, sessile or pedicellate; perianth segments 6, the 3 outer ones calyx-like, tubular, unequal with the odd one anterior, the 3 inner ones corollalike, connate, usually different from the outer in color and texture; fertile stamen 1, the posterior one of the inner whorl, the other two of this whorl united to form a petaloid 2- or 3-lobed labellum, the anterior member of the outer androecial whorl absent, the other two of this whorl sometimes present as staminodes, the anther locules 2, without an apical appendage; ovary inferior, 3-locular, sometimes incompletely so, sometimes 1- or 2-locular, the ovules numerous, usually anatropous, 2-4-seriate, the placentas axile, parietal, or basal, the style filiform, often enveloped in a groove of the fertile stamen, the stigma variable, often ciliate; fruit usually a loculicidal capsule, sometimes baccate and indehiscent, the seeds arillate.

DISTRIBUTION: About 45 genera and 700 species, mostly Indo-Malesian. The family is very important both economically and horticulturally.

USEFUL TREATMENTS OF FAMILY: Schumann, K. Zingiberaceae. Pflanzenr. 20 (IV. 46): 1-458. 1904. Valetton, T. New notes on the Zingiberaceae of Java and Malaya. Bull. Jard. Bot. Buitenzorg II. 27: 1-166. 1918. Loesener, T. Zingiberaceae. Engl. & Prantl, Nat. Pflanzenfam. ed. 2. 15a: 541-640. 1930. Holttum, R.E. The Zingiberaceae of the Malay Peninsula. Gard. Bull. Singapore 13: 1-249. 1950. Burt, B.L. General introduction to papers on Zingiberaceae. Notes Roy. Bot. Gard. Edinburgh 31: 155-165. 1972. Burt, B.L., & R.M. Smith. Tentative keys to the subfamilies, tribes and genera of Zingiberaceae. Op. cit. 31: 171-176. 1972. Burt, B.L., & R.M. Smith. Key species in the taxonomic history of Zingiberaceae. Op. cit. 31: 177-227. 1972.

Seven genera of Zingiberaceae are known to occur in Fiji, but only two of them, *Geanthus* and *Alpinia*, are represented by indigenous species. In the present treatment 17 species are recognized, of which six are indigenous (five of them, all in *Alpinia*, being endemic); the remaining eleven species have been introductions, five of them also being naturalized.

KEY TO GENERA

- Style exerted well beyond fertile part of anther, the elongate anther crest wrapped around style, the stigma not expanded; lateral staminodes adnate to labellum; plane of distichy of leaves parallel to rhizome (tribe Zingibereae) 1. *Zingiber*
- Style not far exerted beyond anther, the anther crest, if present, not wrapped around style, the stigma expanded.
- Distichy of leaves parallel to rhizome; lateral staminodes petaloid, free from labellum (tribe Hedycheae).
- Primary bracts adnate to each other laterally for about half their length, forming basal pouches; inflorescence (in our species) terminal on a short leaf shoot 2. *Curcuma*
- Primary bracts not adnate laterally, boat-shaped, free to base; inflorescence terminal on a tall leafy pseudostem 3. *Hedychium*
- Distichy of leaves transverse to rhizome; lateral staminodes represented by small teeth at base of labellum or absent, rarely forming distinct linear processes or petaloid appendages adnate to lower part of labellum and then pseudostem well developed (tribe Alpinieae).
- Inflorescence borne separately from leaves.
- Main axis of inflorescence usually hidden by imbricating sterile or primary bracts, the inflorescence forming a compact head; base of labellum and filament forming a distinct tube above inner perianth segments; anther more or less emarginate, rarely crested.
- Peduncle up to 1 m. tall, usually erect, always held above ground; inflorescence with a showy involucre of sterile bracts. 4. *Nicolaia*
- Peduncle very short, subterranean; inflorescence with few to many sterile bracts or these lacking, not showy; labellum not conspicuously elongated. 5. *Geanthus*
- Main axis of inflorescence visible; sterile bracts never present, the primary bracts not imbricating; inflorescence lax, prostrate, much elongated. 6. *Elettaria*
- Inflorescence borne on a leafy stem. 7. *Alpinia*

1. ZINGIBER Boehmer in Ludwig, *Defin. Gen. Pl.* ed. 3. 89. 1760; Adanson, *Fam. Pl.* 2: 66. 1763; Seem, *Fl. Vit.* 292. 1868; K. Schum. in *Pflanzenr.* 20 (IV. 46): 165. 1904; Loesener in *Engl. & Prantl, Nat. Pflanzenfam.* ed. 2. 15a: 586. 1930; Holttum in *Gard. Bull. Singapore* 13: 48. 1950. *Nom. cons.*

Erect, robust herbs, the rhizome fleshy, creeping, the pseudostem compact; leaves numerous, the lower ones reduced and sheathlike, the petiole short or none; inflorescence terminal on shoots usually enveloped by bladeless leaf sheaths (in our species), spiciform, the primary bracts numerous, imbricate, each bearing an axillary bracteole and a sessile flower, the bracteole thin, persistent; flowers with the outer perianth segments forming a 3-dentate tube, the inner perianth segments forming a hypocrateriform tube with unequal lobes; staminodes absent; labellum orbicular to ovate from a stalklike basal portion, 3-lobed, opposite the style and stamen; filament short, broad, the anther longer, narrow, its locules dehiscing by slits, the connective prolonged into a narrow appendage clasping the upper part of the style; ovules numerous, in 2 rows in each inner angle of the 3-locular ovary, the stigma with a many-rayed aperture; capsule subtrigonus, loculicidally dehiscent, the seeds black, with a lacerate, white aril (but *Zingiber officinale* seldom fruiting).

TYPE SPECIES: *Zingiber officinale* Roscoe (*Amomum zingiber* L.).

DISTRIBUTION: Eastern Asia through Indo-Malesia to northern Australia, with 80–90 species.

USEFUL TREATMENT OF GENUS: Burt, B.L., & O.A. Olatunji. The limits of the tribe Zingibereae. *Notes Roy. Bot. Gard. Edinburgh* 31: 167–169. 1972.

Two species occur in Fiji; neither is indigenous but one is abundantly naturalized.

KEY TO SPECIES

- Leaf blades 15–25 cm. long, 1.5–3 cm. broad; scape to 12 (–30) cm. tall; inflorescence 4.5–8 cm. long and 1.5–2 cm. broad; bracts with their apical margins incurved; labellum with a rounded, entire apex, dull purple, with cream-colored blotches and base. 1. *Z. officinale*
- Leaf blades 15–35 cm. long, (2.5–) 3.5–8 cm. broad; scape 15–45 cm. tall; inflorescence 6–15 (–20) cm. long and 2.5–5 cm. broad; bracts closely overlapping, their apices not incurved; labellum emarginate at apex, white or pale yellow or a deeper yellow toward base. 2. *Z. zerumbet*

1. ***Zingiber officinale*** Roscoe in Trans. Linn. Soc. **8**: 348. 1807; Seem. Fl. Vit. 292. 1868; K. Schum. in Pflanzenr. **20** (IV. 46): 170. fig. 23. 1904; Valetton in Bull. Jard. Bot. Buitenzorg II. **27**: 128. 1918; Loesener in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. **15a**: 586. fig. 260. 1930; Holttum in Gard. Bull. Singapore **13**: 54. 1950; V.E. Sills in Agr. J. Dept. Agr. Fiji **29**: 13. 1959; J.W. Parham, Pl. Fiji Isl. 261. 1964, ed. 2. 356. 1972; Burt & R.M.Sm. in Notes Roy. Bot. Gard. Edinburgh **31**: 180. 1972; B.E.V. Parham in New Zealand Dept. Sci. Indust. Res. Inform. Ser. **85**: 20. 1972.

Amomum zingiber L. Sp. Pl. I. 1753.

The commercial ginger is cultivated in Fiji but is very doubtfully naturalized. It is an herb with a pale yellowish rhizome, with leafy stems to 75 cm. tall; its bracts are green with a pale submarginal band; its inner perianth segments are yellowish and the labellum is dull purple with cream-colored blotches and base; the anther is cream-colored with a dark purple appendage. Flowering specimens have been noted in March and May, but the season is doubtless longer than this.

TIPIFICATION: After giving several prior references, Linnaeus noted: "*Habitat in Indiis inter tropicos*." Burt & Smith (1972, cited above) found no extant specimens at LINN or BM.

DISTRIBUTION: The country of origin is unknown, but the species has been cultivated in tropical Asia from ancient times and is now grown throughout the tropics.

LOCAL NAMES AND USE: The *ginger* is often known to Fijians as *thangolaya* ni *vavalangi*, *ndanindani*, *layalaya*, and *andi*. There is doubtless some confusion and interchange of local names between this species and the next. *Zingiber officinale* furnishes the ginger of commerce, and the industry in Fiji is well reviewed by Sills (1959, cited above). The species was probably not an aboriginal introduction, but it has now become an important export crop. Parham (1964, 1972, cited above) erroneously indicates that Seemann recorded this species in Fiji; he merely mentioned it in passing in his discussion of *Z. zerumbet*. The actual date of introduction is unknown but presumably was earlier than 1890.

AVAILABLE COLLECTIONS: VITI LEVU: NAITASIRI: Toninaiwau, Tholo-i-suva, DA 16752, 16947; Tamavua, DA 7002.

2. ***Zingiber zerumbet*** (L.) Sm. Exot. Bot. **2**: 105. t. 112. 1806; Roscoe in Trans. Linn. Soc. **8**: 348. 1807; Seem. in Bonplandia **9**: 260. 1861, Viti, 443. 1862, Fl. Vit. 292. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 314. 1892; K. Schum. in Pflanzenr. **20** (IV. 46): 172. fig. 24. 1904; Valetton in Bull. Jard. Bot. Buitenzorg II. **27**: 129. 1918; Guillaumin in J. Arnold Arb. **13**: 110. 1932; Christophersen in Bishop Mus. Bull. **128**: 58. 1935; Yunker in op. cit. **178**: 39. 1943, in op. cit. **184**: 30. 1945; Holttum in Gard. Bull. Singapore **13**: 59. fig. 3. 1950; Yunker in Bishop Mus. Bull. **220**: 85. 1959; Sykes in New Zealand Dept. Sci. Indust. Res. Bull. **200**: 271. 1970; St. John & A.C. Sm. in Pacific Sci. **25**: 346. 1971; J.W. Parham, Pl. Fiji Isl. ed. 2. 356. 1972; Burt & R.M. Sm. in Notes Roy. Bot. Gard. Edin-

burgh 31: 182. 1972; B. E. V. Parham in New Zealand Dept. Sci. Indust. Res. Inform. Ser. 85: 20. 1972.

Amomum zerumbet L. Sp. Pl. 1. 1753.

A second species of *Zingiber*, doubtless an aboriginal introduction, is now so firmly naturalized in Fiji as to appear indigenous. It occurs from near sea level to about 600 m., often locally abundantly, in forest, clearings, beach thickets, and on edges of mangrove swamps. It is an herb with a pale yellowish rhizome, with leafy stems to 2 m. tall; its bracts are green when young, becoming paler and finally red when old; its inner perianth segments are white to pale yellow and the labellum is similar in color or deeper yellow toward base. Flowers have been noted between December and April.

TIPIFICATION: Linnaeus gives several prior references and then notes: "*Habitat in India.*" As for the preceding species, Burt and Smith could not locate an extant specimen at LINN or BM.

DISTRIBUTION: Holtum (1950, cited above) indicates that the original material was from Ceylon, but the species has long been in cultivation in southeastern Asia. More recently it has been widely carried by man throughout the Pacific and is thoroughly naturalized. None of the Fijian specimens are indicated as coming from cultivated plants.

LOCAL NAMES AND USES: *Ndrove* is the usual Fijian name, but also recorded are *mbeta*, *thangolaya*, *ndanindani*, and *layalaya*; some of these names seem to be also applied to the commercial species. The rhizome of *Zingiber zerumbet* can be used for all the purposes of that of *Z. officinale*, although it is less pungent; the rhizome is sometimes used as a medicine for infants' coughs.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Eastern slopes of Mt. Evans Range, *Smith 4010*. SERUA: Taunovo Beach, *Vaughan 3374*. NAMOSI: Mborotu, *DA 11614*. NAITASIRE: Waimanu River, *DA 978*; Nasinu, *DA 7329*; Kalambo, *Tothill 887*. TAILEVU: Nambua, *DA 10128*. KANDAVU, without further locality, *Seemann 623*. VANUA LEVU: MBUA: Liuka Creek, Nasau, *H.B.R. Parham s.n.* MATHUATA: Southern base of Mathuata Range, north of Natua, *Smith 6777*; Wainikoro River, *Greenwood 697*. IHAKAUNDROVE: Near Salt Lake, *DA 16832*; Nasinu, Natewa Bay, *DA 16840*; hills west of Mbutha Bay, Natewa Peninsula, *Smith 804*. TAVEUNI: Trail to lake above Somosomo, *Weiner 12*.

2. *CURCUMA* L. Sp. Pl. 2. 1753; Seem. Fl. Vit. 291. 1868; K. Schum. in Pflanzenr. 20 (IV. 46): 99. 1904; Valetton in Bull. Jard. Bot. Buitenzorg II. 27: 5. 1918; Loesener in Engl. & Prantl. Nat. Pflanzenfam. ed. 2. 15a: 575. 1930; Holtum in Gard. Bull. Singapore 13: 65. 1950.

Erect herbs, the primary rhizome fleshy, ovoid-globose, giving rise to an extensive branch system of secondary and tertiary rhizomes, the pseudostems erect; leaves with a well-developed petiole; inflorescence peduncle with large, bladeless leaf sheaths near base, arising from primary or secondary rhizomes, the inflorescence cylindric, spicate, the primary bracts laterally adnate, forming basal cavities containing flowers, these 2-several, forming a minute, sessile cincinnus; outer perianth segments shorter than the inner, unequally 3-dentate, partially spathaceous, the inner perianth segments tubular at base, infundibular distally, adnate to androecial components; labellum obovate, apically 2-lobed, with lateral lobes arching over the staminodes, these large; filament short, broad, the connective sometimes elongated; ovules numerous in each inner angle of the 3-locular ovary, the style glabrous, the stigma fimbriate; fruit irregularly dehiscent, the arils lacinate.

LECTOTYPE SPECIES: *Curcuma longa* L. (vide Steudel, Nomencl. Bot. 1: 246. 1821). Lectotypification of the genus *Curcuma* and the correct name for the turmeric of commerce are problems too complex to be discussed in detail in the present work.

Valeton (1918, cited above) rejected *C. longa* as a nomen dubium and proposed *C. domestica* Valeton as the name of the cultivated turmeric. Many recent authors have accepted this solution, among them Burt and R. M. Smith (in Notes Roy. Bot. Gard. Edinburgh 31: 179, 209. 1972, in Taxon 21: 709. 1972), who proposed to conserve the name *Curcuma* in the sense of Roxburgh (in Asiatic Res. 11: 329. 1810). Subsequently, however, Burt (in Notes Roy. Bot. Gard. Edinburgh 35: 209-213. 1977) has reversed his opinion, concluding that *C. longa* L. need not be considered a nomen dubium but may be lectotypified by *Manjella kua* Rheede (Hort. Ind. Malabar. 11: 21 t. 11. 1692). If this position is adopted, *C. longa* L. may be accepted as the correct name for the turmeric of commerce and also as the lectotype of the genus *Curcuma*. Without examining the complex arguments further, the reader is referred to Burt's 1977 discussion and his solution is here adopted.

DISTRIBUTION: China and Indo-Malesia; five to ten species are usually recognized, but there is disagreement as to their limits. The only species recorded from Fiji is the turmeric of commerce.

USEFUL TREATMENT OF GENUS: Burt, B. L. The nomenclature of turmeric and other Ceylon Zingiberaceae. Notes Roy. Bot. Gard. Edinburgh 35: 209-215. 1977.

1. *Curcuma longa* L. Sp. Pl. 2. 1753; König in Retz. Obs. Bot. 3: 72. 1783; Seem. in Bonplandia 9: 260. 1861, Viti, 443. 1862, Fl. Vit. 291. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 314. 1892; K. Schum. in Pflanzenz. 20 (IV. 46): 108. 1904; Merr. Interpret. Rumph. Herb. Amb. 163. 1917; Jan in Agr. J. Dept. Agr. Fiji 9 (4): 28. 1938; Yuncker in Bishop Mus. Bull. 178: 40. 1943, in op. cit. 184: 30. 1945, in op. cit. 220: 86. 1959; J. W. Parham, Pl. Fiji Isl. 261. 1964, ed. 2. 355. 1972; B. E. V. Parham in New Zealand Dept. Sci. Indust. Res. Inform. Ser. 85: 13. 1972; Burt in Notes Roy. Bot. Gard. Edinburgh 35: 212. 1977.

Curcuma domestica Valeton in Bull. Jard. Bot. Buitenzorg II. 27: 31. 1918; Holttum in Gard. Bull. Singapore 13: 68, fig. 4. 1950; Burkill, Dict. Econ. Prod. Malay Penins. ed. 2. 716. 1966; Sykes in New Zealand Dept. Sci. Indust. Res. Bull. 200: 271. 1970; St. John & A. C. Sm. in Pacific Sci. 25: 346. 1971; Burt & R. M. Sm. in Notes Roy. Bot. Gard. Edinburgh 31: 185, 203. 1972.

Curcuma sp. Christophersen in Bishop Mus. Bull. 128: 57. 1935.

In Fiji *Curcuma* is naturalized in woods and forest, sometimes locally frequently, at elevations from near sea level to about 250 m. It is an herb forming dense clumps, with leafy pseudostems to about 1 m. high, with white to green bracts; the inner perianth segments are white, and the labellum is cream-white with a yellow median band. However, the species has seldom if ever been found fertile in Fiji.

TIPIFICATION AND NOMENCLATURE: This is discussed above under the genus. For *Curcuma domestica*, Valeton took König's 1783 description as the type; this was based on a now lost König collection from Malaya.

DISTRIBUTION: The country of origin is not definitely known (cf. Holttum, 1950, cited above), but the species is widely cultivated in Indo-Malesia and has been aboriginally introduced throughout the Pacific. In Fiji it is so thoroughly naturalized as to appear indigenous, but it does not appear to be extensively if at all cultivated.

LOCAL NAMES AND USES: *Turmeric*; *thango*; *avea*; *haldi*; *rerenga* (the last perhaps for the prepared powder). The rhizome is used in the preparation of curry; its orange-colored powder is used in various ceremonies, as a cosmetic, sometimes to paint newborn babies, and also as a medicinal poultice to relieve pain.

AVAILABLE COLLECTIONS: YASAWAS: WAYA: Yalombi, St. John 18027. VITI LEVU: NANDRONGA & NAVOSA: In or near the old town of Tonuve, H. B. R. Parham 127, 165. FIJI without further locality, Seemann 622, Horne s. n.

3. *HEDYCHIUM* König in Retz. Obs. Bot. 3: 73. 1783; K. Schum. in Pflanzenr. 20 (IV. 46): 40. 1904; Turrill in Kew Bull. 1914: 368. 1914; Loesener in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. 15a: 560. 1930; Holttum in Gard. Bull. Singapore 13: 72. 1950; Burtt & R. M. Sm. in Notes Roy. Bot. Gard. Edinburgh 31: 197. 1972.

Erect, often tuberous, comparatively tall herbs with well-developed pseudostems; leaves with short or no petiole, the ligule conspicuous; inflorescence many-flowered, terminal on pseudostem, pedunculate, spicate, cylindric to ovoid, the bracts numerous, imbricate, the primary ones bearing a cincinnus often with 1-3 flowers, the upper bracts with involute margins, the bracteoles tubular-connate; flowers fragrant, the outer perianth segments forming a long, narrow tube unequally dentate at apex, the inner perianth segments larger, membranaceous, with unequal lobes; staminodes well developed, ligulate, entire at apex; labellum obcordate, narrowed proximally, 2-lobed distally, comparatively large; filament long, linear, the anther broadly linear, with basal appendages; ovules numerous, biseriate in the inner angles of the 3-locular ovary, the style slightly exceeding anther in length, the stigma ciliate; fruit loculicidally 3-valved, the seeds with lacinate arils.

TYPE SPECIES: *Hedychium coronarium* König.

DISTRIBUTION: From Madagascar to southwestern China and eastward into Indo-Malesia, with about 50 species, some of which are widely cultivated and naturalized elsewhere.

Turrill (1914, cited above) has published an informative discussion of *Hedychium coronarium* and its allies. In addition to the two species discussed below, Christopherson and Yuncker (in Bishop Mus. Bull. 128: 57. 1935, in op. cit. 178: 40. 1943) have recorded *H. flavum* Roxb. in Samoa and Niue, but it has not been reported from Fiji.

KEY TO SPECIES

- Flowers white, the labellum with a pale greenish spot within, the staminodes and labellum comparatively broad; inflorescence with imbricate bracts; cultivated and naturalized. 1. *H. coronarium*
Flowers yellow, the stamen red, the staminodes and labellum comparatively narrow; inflorescence comparatively open, the bracts scarcely imbricate; cultivated only. 2. *H. gardnerianum*

1. *Hedychium coronarium* König in Retz. Obs. Bot. 3: 73. 1783; K. Schum. in Pflanzenr. 20 (IV. 46): 44. fig. 8, A, C. 1904; Turrill in Kew Bull. 1914: 368. fig. 1. 1914; Loesener in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. 15a: 560. fig. 245. 1930; A. C. Sm. in Bull. Torrey Bot. Club 70: 535. 1943; Yuncker in Bishop Mus. Bull. 220: 85. 1959; J. W. Parham in Agr. J. Dept. Agr. Fiji 29: 32. 1959, Pl. Fiji Isl. 261. 1964, ed. 2. 355. 1972; St. John & A. C. Sm. in Pacific Sci. 25: 346. 1971; Burtt & R. M. Sm. in Notes Roy. Bot. Gard. Edinburgh 31: 197. 1972.

The white ginger is cultivated in Fiji and is also firmly naturalized along roads and trails and in thickets, often being locally abundant at elevations from near sea level to 200 m. or perhaps higher. It is a coarse herb 1-3 m. high, with green bracts and very fragrant pure white flowers. Flowers have been collected between February and April but doubtless occur at other seasons.

TIPIFICATION: The original material was obtained in Malaya by König, but no extant specimen seems to be available (Burtt and Smith, 1972, cited above).

DISTRIBUTION: Probably a native of the Himalayas and southwestern China, this species is widely cultivated and is naturalized in many Pacific areas. Its occurrence in Fiji may be comparatively recent, as none of the early collectors seem to have noted it.

LOCAL NAMES AND USES: *Thevunga* is the most frequent Fijian name, but it is sometimes known as *ndrove*, and in English as *white ginger*. It is a highly ornamental plant and its flowers are worn by dancers and others. In Tonga (Yuncker, 1959, cited above) the leaves are used for scenting oil, and elsewhere paper is made from the tough pseudostems.

AVAILABLE COLLECTIONS: VITI LEVU: NAITASIRI: Toninaiwau, Tholo-i-suva, DA 16750. TAILEVU: Hills east of Wainimbuka River, near Ndakuivuna, Smith 7002. REWA: Suva Botanical Gardens, DA 12337. KORO: East coast, Smith 1098. VANUA LEVU: THAKAUNDROVE: Along trail from Mbiangunu to Vemsi over Mt. Mariko, Bierhorst F149. FIJI without further locality, Gillespie 4394.

2. *Hedychium gardnerianum* Lindl. in Bot. Reg. 9: t. 774. 1824; Roscoe, Monandr. Pl. Scit. t. 62. 1828 (?); K. Schum. in Pflanzenr. 20 (IV. 46): 56. 1904; J. W. Parham, Pl. Fiji Isl. ed. 2. 355. 1972.

The second *Hedychium* known to occur in Fiji is only sparsely cultivated. It is a coarse herb 1–2 m. high, with the inflorescence as long as 30–45 cm., the flowers being yellow except for the bright red stamen. The only available specimen was in flower in March.

TIPIFICATION: The type was from a cultivated plant, sent from Calcutta by Wallich in 1819 with the suggestion that it be named for Edward Gardner, then the East India Company's resident at the seat of the Nepal government.

DISTRIBUTION: Himalayas and adjacent areas, but now cultivated elsewhere, although much less frequently than the preceding species.

LOCAL NAME AND USE: *Yellow ginger*. This ornamental is known in Hawaii as the *kahili ginger*.

AVAILABLE COLLECTION: VITI LEVU: REWA: Suva Botanical Gardens, DA 12338.

4. NICOLAIA Horan. Prodr. Monogr. Scitam. 32. 1862; Backer & Bakh. f. Fl. Java 3: 62. 1968; Burt & R. M. Sm. in Notes Roy. Bot. Gard. Edinburgh 31: 210. 1972.

Phaeomeria Lindl. Nat. Syst. Bot. ed. 2. 446, nom. nud. 1836, ex K. Schum. in Pflanzenr. 20 (IV. 46): 261. 1904; Holttum in Gard. Bull. Singapore 13: 178. 1950.

Erect, stout, several-stemmed, tall herbs, the rhizome creeping, branched, the pseudostems robust, unbranched, thickened near base; leaves numerous, the lower ones sheathing, the petiole short, the ligule well developed; inflorescences ovoid or subglobose, arising laterally near bases of pseudostems, the peduncle usually erect and conspicuous, with large, coriaceous scales, the inflorescence bracts numerous, persistent, the outer ones sterile, imbricate, the inner ones smaller, fertile, each with a single bracteole and flower, the bracteole tubular; outer perianth segments narrowly tubular, the inner perianth segments shorter than the outer ones, with subequal lobes; labellum spatulate, distally ovate, basally adnate with the filament to form a tube, the free part of the filament short, the anther elongate, somewhat emarginate; ovules numerous at each inner angle of the 3-locular ovary, the style slender, the stigma broad; fruits indehiscent, in globose or ovoid heads, the seeds numerous.

TYPE SPECIES: *Nicolaia* is typified by *N. imperialis* Horan. (= *Alpinia elatior* Jack) = *N. elatior* (Jack) Horan.; *Phaeomeria* by *P. magnifica* (Roscoe) K. Schum. (*Alpinia magnifica* Roscoe). The two specific taxa are now considered synonyms.

DISTRIBUTION: Indo-Malesia, with about 25 species.

In taking up the generic name *Nicolaia* in place of the long-used *Phaeomeria*, the authors cited above point out that Lindley in 1836 did not validly publish the latter name. This is doubtless the correct conclusion (cf. Art. 32, ICBN), and apparently *Phaeomeria* was validated only by Schumann in 1904. A generic name earlier than *Nicolaia* exists in *Diracodes* Bl., based on *D. javanica* Bl. (Enum. Pl. Javae, 55. 1827), but the type specimen is said to be an invirescent form of *N. elatior*. *Diraco-*

des is therefore rejected by Backer and Bakhuizen, and also by Burtt and Smith, as being based on a monstrosity (Art. 71, ICBN). I am inclined to question this decision, since Art. 71 has proved notoriously difficult to interpret. If *D. javanica* is merely an aberrant form of *N. elatior* and can be positively identified with it, the word "monstrosity" may not be nomenclaturally applicable. In order to preserve current usage for this spectacular genus, it is probable that *Nicolaia* should be formally conserved over *Diracodes*.

1. ***Nicolaia elatior*** (Jack) Horan. Prodr. Monogr. Scitam. 32. *t. 1*. 1862; Merr. in J. Arnold Arb. 33: 215. 1952; Burtt & R. M. Sm. in Notes Roy. Bot. Gard. Edinburgh 31: 210. *fig. 17B*. 1972.

Alpinia elatior Jack in Malayan Misc. 2: 2. 1822.

Elettaria speciosa Bl. Enum. Pl. Javae, 51. 1827.

Alpinia magnifica Roscoe, Monandr. Pl. Scit. *t. 75*. 1828; Hook. in Bot. Mag. 59: *t. 3192*. 1832.

Alpinia speciosa D. Dietr. Syn. Pl. 1: 13. 1839.

Nicolaia imperialis Horan. Prodr. Monogr. Scitam. 32. 1862.

Nicolaia speciosa Horan. Prodr. Monogr. Scitam. 32. 1862.

Amomum magnificum Benth. & Hook. f. ex B. D. Jacks. Ind. Kew. 1: 108. 1895; J. W. Parham in Agr. J. Dept. Agr. Fiji 29: 31. 1959; Pl. Fiji Isl. 261. 1964.

Phaeomeria magnifica K. Schum. in Pflanzenr. 20 (IV. 46): 262. *fig. 32*. 1904; Loesener in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. 15a: 594. *fig. 264*. 1930.

Phaeomeria speciosa Koorders, Exkursiönsfl. Java 1: 332. 1911, op. cit. 4: 318. *fig. 564*. 1923; Merr. Enum. Philipp. Fl. Pl. 1: 241. 1924; Holttum in Gard. Bull. Singapore 13: 181. 1950; J. W. Parham, Pl. Fiji Isl. ed. 2. 355. 1972.

Phaeomeria imperialis Lindl. ex Holttum in Gard. Bull. Singapore 13: 179, pro syn. 1950.

This showy plant, known only in cultivation in Fiji, is a coarse herb growing in large clumps 3–6 m. high; its leaves are up to 85 × 18 cm.; the scape may be as much as 1.5 m. tall, and the inflorescence bracts are bright red; the inner perianth segments are pink, the labellum being red with a yellow or white margin and the anther red; the fruits are green to reddish. Flowers have been noted in January and July but doubtless occur throughout the year.

TYPIFICATION AND NOMENCLATURE: Four basionyms, all now accepted as representing the same taxon, are involved in the complicated synonymy. *Alpinia elatior* is typified by a specimen collected by Jack (and presumably now lost) on the west coast of Sumatra. *Elettaria speciosa* is presumably based on a Blume collection ("*Crescit in sylvis humidis Javae insulae.*"). The original drawing of *Alpinia magnifica* was made in 1826 by Charles Telfaire in Mauritius, from a plant said to be native in Madagascar; this drawing, accompanied by pressed flowers, reached Roscoe through Robert Barclay, of Buryhill, and Hooker, then at the University of Glasgow. The accompanying dried leaves, according to Roscoe, belonged to a species of *Zingiber*; probably the original plate of Roscoe is best considered the type. *Nicolaia imperialis* was probably described from a cultivated plant.

DISTRIBUTION: Widely distributed in Malesia, subsequently introduced into the Philippines, and now widely cultivated elsewhere.

LOCAL NAME AND USE: *Torch ginger*; ornamental, considerably more common in Suva gardens than suggested below.

AVAILABLE COLLECTIONS: VITI LEVU: REWA: Suva Botanical Gardens, DA 12164; Suva, in private garden, DA 16082, 16099.

5. **GEANTHUS** Valetton in Bot. Jahrb. 52: 43. 1914; Loesener in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. 15a: 591. 1930; Burtt & R. M. Sm. in Notes Roy. Bot.

Gard. Edinburgh 31: 179, 221. 1972, in Taxon 21: 709. 1972. Nom. cons. propos. (non Raf., 1814, nec Reinw., 1825, nec Philippi, 1884).

Amomum sensu Seem. Fl. Vit. 290. 1868; non Roxb., 1820, nom. cons.

Amomum sect. *Geanthus* K. Schum. in Pflanzenr. 20 (IV. 46): 223. 1904.

Comparatively low herbs, the rhizome creeping, the inflorescence borne on a leafless shoot separately from the leafy pseudostem, the peduncle short, subterranean; inflorescence spicate, involucrate, forming a compact head, rounded at apex, with few to many sterile bracts, these not showy but the main axis usually hidden by them; outer perianth segments persistent; inner perianth segments longer than the outer ones; basal parts of labellum and filament fused to form a distinct tube above inner perianth segments; labellum not lobed but sometimes slightly emarginate, not conspicuously elongated, the free part of the filament short, the anther somewhat emarginate, not crested; ovules numerous at each inner angle of the 3-locular ovary, the stigma expanded; fruit a more or less spherical, dry or fleshy capsule.

TYPE SPECIES: *Geanthus roseus* (Teys. & Binn.) Loesener (*Donacodes roseus* Teys. & Binn.). Typ. cons. propos.

DISTRIBUTION: Indo-Malesia and into the Pacific, with more than 40 species.

The complicated history of the generic name *Geanthus* was fully explored by Burtt and Smith (1972, two publications cited above). Briefly, the genus as accredited to Reinwardt (1825) cannot be used in the sense of practically all recent students of Zingiberaceae, who in this respect follow Loesener (1930, cited above). None of the original species of *Geanthus* Reinw. were retained in *Amomum* sect. *Geanthus* in the sense of Schumann (1904, cited above). It is in this latter sense that Valeton reconstituted *Geanthus* as a genus in 1914 and Loesener adopted it in 1930. In order to retain this usage, Burtt and Smith have proposed to conserve the generic name in Valeton's sense, a proposal that would allow continuation of the current usage of many binomials. The Committee for Spermatophyta (in Taxon 23: 822. 1974) has rejected the proposal of Burtt and Smith, pointing out that some taxonomists consider *Geanthus* Valeton (1914) to be a taxonomic synonym of *Achasma* Griffith (1851). These two genera are certainly closely related and perhaps will eventually be combined, but other nomenclatural complications were discussed by the Committee. In spite of the objections, I am inclined to agree with Burtt and Smith that a very prolonged period of study will be required before the status of all the concerned names becomes clear; in the meantime some 40 or more species of *Geanthus* Valeton will be in a state of nomenclatural confusion. The generic name *Amomum* definitely cannot be used for the many species now placed in *Geanthus*, since *Amomum* Roxb. (1820) has been conserved in the ICBN over *Amomum* L. (1753), the latter now being referred to *Zingiber* L. (cf. Burtt & R. M. Sm. in Taxon 17: 730. 1968). The acceptance of *Amomum* Roxb. in a very inclusive sense (cf. Backer & Bakh. f. Fl. Java 3: 51. 1968) seems an unsatisfactory solution. (For a taxonomic characterization of *Amomum* Roxb., see Burtt & R. M. Sm. in Notes Roy. Bot. Gard. Edinburgh 31: 174. 1972.) In short, it would seem that the rejected proposal offers the only, albeit temporary, nomenclatural solution to this involved situation, and I here adopt it rather than seek or propose a different name for *Geanthus cevuga*, discussed below, hoping that the Committee for Spermatophyta will reconsider its decision or will suggest an alternative solution.

1. *Geanthus cevuga* (Seem.) Loesener in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. 15a: 591, 593. 1930.

Amomum sp. Seem. in Bonplandia 9: 260. 1861, Viti, 443. 1862.

Amomum cevuga Seem. Fl. Vit. 291. t. 89. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 314. 1892; K. Schum. in Pflanzenr. 20 (IV. 46): 231. 1904; F. Br. in Bishop Mus. Bull. 84: 168. 1931; J. W. Parham, Pl. Fiji Isl. 261. fig. 91. 1964, ed. 2. 355. 1972.

Amomum vignauai Rechinger in Repert. Sp. Nov. 4: 228. 1907.

Geanthus vignauai Loesener in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. 15a: 591, 593. 1930; Christophersen in Bishop Mus. Bull. 128: 58. 1935; B. E. V. Parham in New Zealand Dept. Sci. Indust. Res. Inform. Ser. 85: 21, as *G. vignauai*. 1972.

The single species of *Geanthus* known from Fiji occurs in forest at an elevation of about 200–400 m. (up to 800 m. in Samoa). It is an herb with an elongate leafy pseudostem 2–4 m. high arising from a freely branched rhizome; the inflorescence is separately borne on a leafless scape 5–15 cm. high, with purple bracts; the inner perianth segments are pale rose or salmon-pink.

TIPIFICATION AND NOMENCLATURE: The holotype is *Seemann 624* (κ), collected between Aug. 22 and Sept. 2, 1860, in Namosi Province (and probably near Namosi Village), Viti Levu. The type of *Amomum vignauai* is *Rechinger s. n.* (HOLOTYPE probably at w), collected on Savaii without further locality, Samoa. I believe that these two taxa have not previously been combined. Examination of Seemann's excellent illustration, Rechinger's original description, Loesener's key characters, and collections from Samoa and the Society Islands fails to disclose any consequential differences.

DISTRIBUTION: Fiji, Samoa, and the Society Islands; introduced into the Marquesas according to F. Brown (1931, cited above). It is rare in Fiji (known only from the type and a single other collection from the same area) and in the Societies but somewhat more frequent in Samoa. The intriguing possibility exists that *Geanthus cevuga* is still another zingiberaceous aboriginal introduction from Malesia into the Pacific area, but on the basis of our present inadequate knowledge the species may be considered indigenous at least in Fiji and Samoa. Seemann utilized the "Fijian" spelling of the local name for his specific epithet, although elsewhere (e. g. the genus *Thakombauia* (now referred to *Flacourtia*), named to honor King Cakobau), he adopted "phonetic" spelling.

LOCAL NAMES AND USES: *Thevunga*; *thevunga ndamu*. Seemann notes that the leaves are used for making into necklaces, for scenting coconut oil, and as an ingredient of curry. Weiner has indicated that the leaves are crushed and inhaled to clear stuffed nasal passages.

AVAILABLE COLLECTION: VITI LEVU: NAMOSI: Across Waindina River from Namosi Village, *Weiner 8*.

In mentioning this as a common plant in Fiji and in calling it *white ginger*, J. W. Parham has apparently confused its records with those of *Hedychium coronarium*, also known as *thevunga*.

6. *Elettaria* Maton in Trans. Linn. Soc. 10: 254. 1811; K. Schum. in Pflanzenr. 20 (IV. 46): 267. 1904; Loesener in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. 15a: 603. 1930; Holttum in Gard. Bull. Singapore 13: 236. 1950.

Comparatively low herbs with horizontal rhizomes, the inflorescence borne separately from the leafy pseudostem, prostrate, much elongated, sometimes more or less subterranean, lax, the main axis visible, the primary bracts present but not imbricate, sterile bracts absent; flowers in several-flowered cincinni, the outer perianth segments persistent, forming a 3-lobed tube, exceeded in length by the inner perianth segments; labellum large, obovate from a narrowed base, not lobed; lateral stamens lacking; free portion of filament short, the anther crest small and inconspicuous.

ous; ovules numerous at each inner angle of the 3-locular ovary, the stigma expanded.

TYPE SPECIES: *Elettaria cardamomum* (L.) Maton (*Amomum cardamomum* L.). Although *Amomum* L. was originally described with four species, it is now lectotypified in the ICBN by *A. zingiber* L. and the generic name in Linnaeus's sense has become a direct synonym of *Zingiber* L.

DISTRIBUTION: Indo-Malesia, with about seven species, one of which is widely cultivated.

1. *Elettaria cardamomum* (L.) Maton in Trans. Linn. Soc. **10**: 254. *t.* 5. 1811; K. Schum. in Pflanzenr. **20** (IV. 46): 268. *fig.* 33. 1904; Loesener in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. **15a**: 603. *fig.* 268. 1930; J. W. Parham, Pl. Fiji Isl. 261. 1964, ed. 2. 355. 1972; Burt & R. M. Sm. in Notes Roy. Bot. Gard. Edinburgh **31**: 182. 1972; B. E. V. Parham in New Zealand Dept. Sci. Indust. Res. Inform. Ser. **85**: 45. 1972.

Amomum cardamomum L. Sp. Pl. 1. 1753.

The *cardamom* is sparingly cultivated in Fiji near sea level; its leafy pseudostem attains a height of 3 m. and its inflorescence is characteristically prostrate; the inner perianth segments are white; the labellum has a yellow median band and margins and red stripes.

TYPIFICATION: Burt and Smith (1972, cited above) indicate that the only satisfactory lectotype is *Elettari* Rheede, Hort. Ind. Malabar. **11**: 9. *t.* 5. 1692.

DISTRIBUTION: India, but now in wide cultivation; no Fijian collections have been seen.

LOCAL NAME AND USES: *Cardamom* is the widespread name in cultivation; the spicy seeds are used for flavoring food and beverages, for medicinal purposes, and for chewing. An interesting account of the genus is provided by Burkill, Dict. Econ. Prod. Malay Penins. ed. 2. 925-930. 1966.

7. *ALPINIA* Roxb. in Asiat. Res. **11**: 350. 1810; Seem. Fl. Vit. 290. 1868; K. Schum. in Pflanzenr. **20** (IV. 46): 308. 1904; Holtum in Gard. Bull. Singapore **13**: 140. 1950; Burt & R. M. Sm. in Notes Roy. Bot. Gard. Edinburgh **31**: 186. 1972. Nom. cons.

Catimbium sensu Lestib. in Ann. Sci. Nat. II. **15**: 346. 1841; Holtum in Gard. Bull. Singapore **13**: 149. 1950; non Juss.

Erect, mostly comparatively large herbs with several pseudostems, the rhizome creeping, fleshy, the leaves numerous, distichous, the lower ones sheathing to form a pseudostem, the petiole long, the ligule well developed, the blade penninerved, entire or bilobed at apex; inflorescence terminal on leafy pseudostems, paniculate or racemiform, lax to capitular, erect or nodding or pendulous, when young surrounded at base by spathe-like primary bracts, the lateral axes, if present, bearing 1-many-flowered cincinni; bracts of inflorescence axis and lateral branches small to large, sometimes deciduous or absent; bracteoles open to base or tubular, persistent or caducous, enclosing the part of the cincinnus beyond it; outer perianth segments forming a funnel-shaped or tubular calyx, this shallowly or deeply cleft, the inner perianth segments corolline, with a tube usually not exceeding the outer segments, the posterior lobe the largest; labellum entire or lobed at apex; staminodes usually present, variable, small; filament well developed, longer than anther, the anther locules divided by a broad connective, this apically prolonged or not, the locules dehiscing by longitudinal slits; stylodes 2; ovary 3-locular or incompletely so, the ovules numerous, axile or essentially so; fruit a capsule crowned by the calyx remnant; seeds several or numerous, arillate.

TYPE SPECIES: *Alpinia galanga* (L.) Willd. (*Maranta galanga* L.). Typ. cons. *Catimbum* Juss. was a new name for *Reinealmia* L. f. (now conserved) and it must be similarly typified by *R. exaltata* L. f. *Reinealmia* occurs in tropical America and Africa. *Catimbum* cannot be utilized as a generic name for any Indo-Malesian species; however, in the sense of Lestiboudois it may be lectotypified by *Alpinia zerumbet* and legitimately used as a subgeneric or sectional name in *Alpinia*. The generic name *Languas* König, sometimes utilized for certain Indo-Malesian species of *Alpinia*, is typified by *Maranta galanga* L. and consequently is a direct generic synonym of *Alpinia* Roxb.

DISTRIBUTION: Tropical Asia through Malesia and into the Pacific, with about 250–300 species. Nine species are recorded from Fiji, of which five are indigenous.

USEFUL TREATMENT OF GENUS: Smith, R.M. A preliminary review of the large bracteate species of *Alpinia*. Notes Roy. Bot. Gard. Edinburgh 34: 149–182. 1975.

The genus *Alpinia* has been greatly clarified in recent years through the efforts of Holttum (1950, cited above under the family) and Burtt and R.M. Smith (in various papers published in Notes Roy. Bot. Gard. Edinburgh, 1972–1975). Holttum is of the opinion that *Alpinia*, as taken up by Schumann in 1904, should be divided into four genera, a viewpoint that has much in its favor. But (cf. Burtt & R.M. Sm. in Notes Roy. Bot. Gard. Edinburgh 31: 178. 1972) the generic nomenclature is still confused, and taxonomic concepts are not yet sufficiently firm to permit an adequate understanding of the complex, which for the time being is more satisfactorily maintained in the inclusive sense. Even though the species occurring in Fiji are on the merest fringe of the generic distribution, their nomenclature illustrates some of the problems involved. Following the suggestion of R.M. Smith (1975, cited above), the term “bract” is here used to describe the bracts of the main rachis and lateral branches of the inflorescence; the term “bracteole” refers to all bracts arising on the cincinnus.

KEY TO SPECIES

Bracteoles tubular, closed at least in basal portion (subgen. *Dieramalpinia*).

Bracts less than 1 cm. long and often negligible; bracteoles tubular and usually telescoping in (1-) 2-many-flowered cincinni; inflorescences paniculate, with lateral branches bearing several cincinni (sect. *Pycnanthus*); indigenous species.

Plants robust, 2–8 m. high, the pseudostem stout, often more than 10 cm. in diameter; inflorescence dependent, 0.7–1.5 m. long, with (5-) 30–60 or more lateral branches, these 5–30 cm. long (or shorter only toward apex of inflorescence), each bearing (3-) 5–17 cincinni, the bracteoles in each cincinnus (1-) 2–30; leaf blades at maturity 100–200 cm. long, 13–30 cm. broad.

Lateral branches of inflorescence 30–60 or more, separated in midportion of inflorescence by 1–4 cm. of exposed rachis, 2–20 cm. long (or negligible toward apex of inflorescence); cincinni on lateral branches of inflorescence separated by (2-) 4–10 mm.; lowermost bracteole of each cincinnus 5–17 mm. long and 5–9 mm. in diameter at apex, persistently sericeous; pedicels 5–10 mm. long; outer perianth segments connate in a tube 3–7 mm. long.

Lowermost bracteole of each cincinnus narrowly cylindric-campanulate, (7-) 10–17 mm. long and 5–7 mm. in diameter at apex, pale brown-sericeous without; number of bracteoles in a cincinnus eventually up to 30; inner perianth segments and labellum comparatively sparsely glandular-punctate. 1. *A. boia*

Lowermost bracteole of each cincinnus cylindric-cupuliform, 5–8 mm. long and 6–9 mm. in diameter at apex, dark brown-sericeous without; number of bracteoles in a cincinnus not noted as more than 6; inner perianth segments and labellum copiously and conspicuously glandular-punctate. 2. *A. horneana*

Lateral branches of inflorescence 5–10, separated in midportion of inflorescence by 4–10 cm. of exposed rachis, up to 30 cm. long; cincinni on lateral branches of inflorescence usually separated by 20–60 mm.; lowermost bracteole of each cincinnus 20–30 mm. long and 7–12 mm. in diameter at apex, glabrous except distally; pedicels 20–40 mm. long; outer perianth segments connate in a tube 12–20 mm. long. 3. *A. parksii*

- Plants comparatively small, 0.5–2 m. high, the pseudostem less than 1 cm. in diameter; inflorescence compact, suberect, 5–9 cm. long and broad, with 5–15 lateral branches, these very short, each bearing 2–5 cincinni, the bracteoles in each cincinnus usually 1, rarely 2 or 3; leaf blades up to 45 × 9 cm. but usually smaller. 4. *A. vitiensis*
- Bracts large, persistent, often 2–10 cm. long.
 Inflorescence narrowly paniculate, erect or nodding but not congested, the flowers often sterile or lacking in cultivation.
 Leaf blades green; inflorescence erect, with bright red or rich pink bracts; inner perianth segments united in a slender tube long exserted from the tube of the outer segments; labellum broad and petaloid, with conspicuous lateral lobes (sect. *Guillainia*); cultivated or naturalized. 5. *A. purpurata*
- Leaf blades green- and white- or yellow-streaked; inflorescence nodding, with greenish bracts; inner perianth segments united in a tube scarcely exserted from the tube of the outer segments; labellum oblong, with inconspicuous lateral teeth (sect. *Eubractea*); cultivated only. 6. *A. vittata*
- Inflorescence at first capitate and tightly congested, 7–14 cm. in diameter, with outermost primary bracts 7–15 × 6–8 cm., at length becoming tightly paniculate and up to 20 cm. long and broad, with 5–10 scarcely distinguishable lateral branches, each of these bearing many open, linear bracts 7–10 cm. long, the ultimate bracts subtending cincinni; cincinnus with an outer tubular bracteole 7–8.5 cm. long and 6–8 mm. in diameter, this oblique at apex but only shallowly cleft on one side, containing a narrow developing flower laterally appressed to another tubular bracteole, the number of flowers and bracteoles in a cincinnus usually 4 or 5, the inner bracteoles progressively shorter and apically more oblique; mature flowers 7–8 cm. long, the outer perianth segments obliquely fused in a calycine tube 3–4 cm. long, this cleft nearly to middle and 3-dentate at apex, the inner perianth segments with a tube about as long as the tube of the outer segments; labellum ligulate, the filament broad, with subulate teeth below anther, the style, labellum, and stamen about as long as the inner perianth segments (sect. *Anomiceps*); indigenous species. 7. *A. macrocephala*
- Bracteoles open to base; inflorescence racemose, the bracts subtending cincinni lacking or usually very small, the cincinni 1–3-flowered; labellum conspicuous, 3–4 cm. long, yellow with red or crimson markings (subgen. *Catimbium*); cultivated or perhaps sparingly naturalized.
 Leaf blades comparatively large, up to 70 × 12 cm., the sheaths 3–4 cm. broad; inflorescence nodding, to 30 cm. long, the bracteoles about 2.5 cm. long, persistent, the cincinni with 1 or 2 flowers. 8. *A. zerumbet*
- Leaf blades smaller, up to 50 × 5 cm., the sheaths 0.6–1.5 cm. broad; inflorescence suberect, to 18 cm. long, the bracteoles 0.5–1.5 cm. long, caducous, the cincinni with 2 or 3 flowers. 9. *A. mutica*

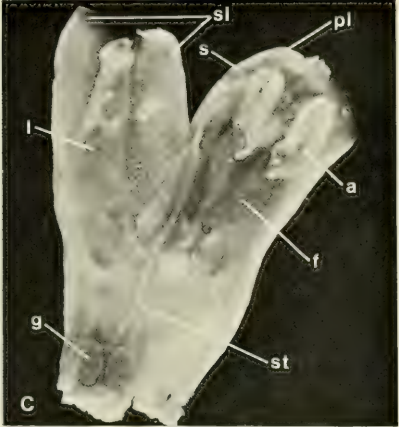
1. *Alpinia boia* Seem. Fl. Vit. 290. pl. 88. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 315. 1892; K. Schum. in Pflanz. 20 (IV. 46): 348. 1904; J. W. Parham, Pl. Fiji Isl. 259. fig. 90. 1964, ed. 2. 354. 1972. FIGURE 52.

Gen. nov. vulgo "Boia" Seem. in Bonplandia 9: 260. 1861; Viti, 443. 1862.

Alpinia hemsleyana K. Schum. in Pflanz. 20 (IV. 46): 348. 1904; A. C. Sm. in J. Arnold Arb. 31: 147. 1950; J. W. Parham, Pl. Fiji Isl. 260. 1964, ed. 2. 354. 1972.

This massive herb, 3–8 m. high, is a locally frequent and striking component of the Fijian forest, found at elevations from near sea level to 900 m. It has leaf blades as much as 2 m. long and a dependent inflorescence to 1.5 m. long. The bracteoles are dull orange, the tubular outer perianth segments dull yellowish white, pink-tinged, or greenish yellow, the inner perianth segments white or yellowish white or greenish yellow, the stamen yellowish white, and the fruit pale yellow. It may be found in flower and fruit throughout the year.

FIGURE 52. *Alpinia boia*; A, a lateral inflorescence branch with six cincinni, one of them bearing a maturing terminal flower, × 1; B, longitudinal section of a cincinnus showing telescoping bracteoles, the ultimate one with a developing flower and a new bracteole enclosing a flower bud, × 2; C, opened inner perianth, showing the posterior lobe (pl), the two smaller lobes (sl), the labellum (l), the filament (f) with two anther locules (a), the style (st), stigma (s), and epigynous glands (g), × 4; D, mature flower, × 6; A, C, & D from *Smith 7868*, B from *Smith 8938*.



TYPIFICATION AND NOMENCLATURE: The holotype is *Seemann 620* (κ), collected between Aug. 22 and Sept. 3, 1860, in Namosi Province, Viti Levu, "on the road from Navua to Namosi" (probably meaning between the Navua River and Namosi Village). The holotype of *Alpinia hemsleyana* is *Horne 593* (κ), collected in March, 1878, on the island of Rambi. The type specimen of the latter seems merely to represent a less mature plant than that of *A. boia*, with smaller leaves and fewer-flowered cincinni. On individual specimens of *A. boia* the number of bracteoles and flowers in a cincinnus may vary from one (on those cincinni just beginning to develop) to 30 or perhaps more. Leaf size in this group of species is subject to great variation.

DISTRIBUTION: Endemic to Fiji, and thus far known from the islands of Viti Levu, Ngau, Vanua Levu, and Rambi. It is cultivated elsewhere, at least in Hawaii.

LOCAL NAMES: *Mboia* is the usual Fijian name, but *vava* is also recorded. The fruit is said to be attractive to pigeons.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Vicinity of Nandarivatu, *Degener & Ordenez 13580*, *Degener 14353*; Nandala, *O. & I. Degener 32011*; slopes of Mt. Tomanivi, *DA 12774* (*Melville et al. 7166*). SERUA: Ndeumba, west of Navua, *DA 9218* (*McKee 2782*). NAMOSI: Hills east of Wainikoroiluva River, near Namuamua, *Smith 8914*, *8938*. NAITASIRI: Waindina River basin, *MacDaniels 1058* (*Tothill 889*); Tholo-i-suva, *Bryan 206*, *Vaughan 3171*, *DA 202*, *11876*, *12983*; vicinity of Tamavua, *Gillespie 2190*; vicinity of Nasinu, *Gillespie 3668*. TAILEVU: Hills east of Wainimbuka River, vicinity of Ndakuivuna, *Smith 7139*. REWA: Slopes of Mt. Korombamba, *H. B. R. Parham 21*; Suva Range, Nggoya, *DA L.9559*. NGAU: Slopes of Mt. Ndelaitho, on northern spur toward Navukailangi, *Smith 7868*. VANUA LEVU: THAKAU-NDROVE: Eastern drainage of Yanawai River, *Degener & Ordenez 14083*. FIJI without further locality, *Horne 1*, *2*.

2. *Alpinia horneana* K. Schum. in *Pflanzenr.* **20** (IV. 46): 349. 1904; J. W. Parham, *Pl. Fiji Isl.* 260. 1964, ed. 2. 354. 1972. FIGURE 53.

A coarse herb up to 7.5 m. high, with leaves to 2 m. long and a dependent inflorescence to 1.2 m. long. It has been collected in moist forest at elevations up to 180 m.; the inner perianth segments are said to be yellowish and the fruit green. Flowers and fruits are thus far known only from material collected in November and December.

TYPIFICATION: The holotype is *Horne s. n.* (κ), collected Dec. 1, 1877, in Fiji without further locality (but from the date probably on Ovalau).

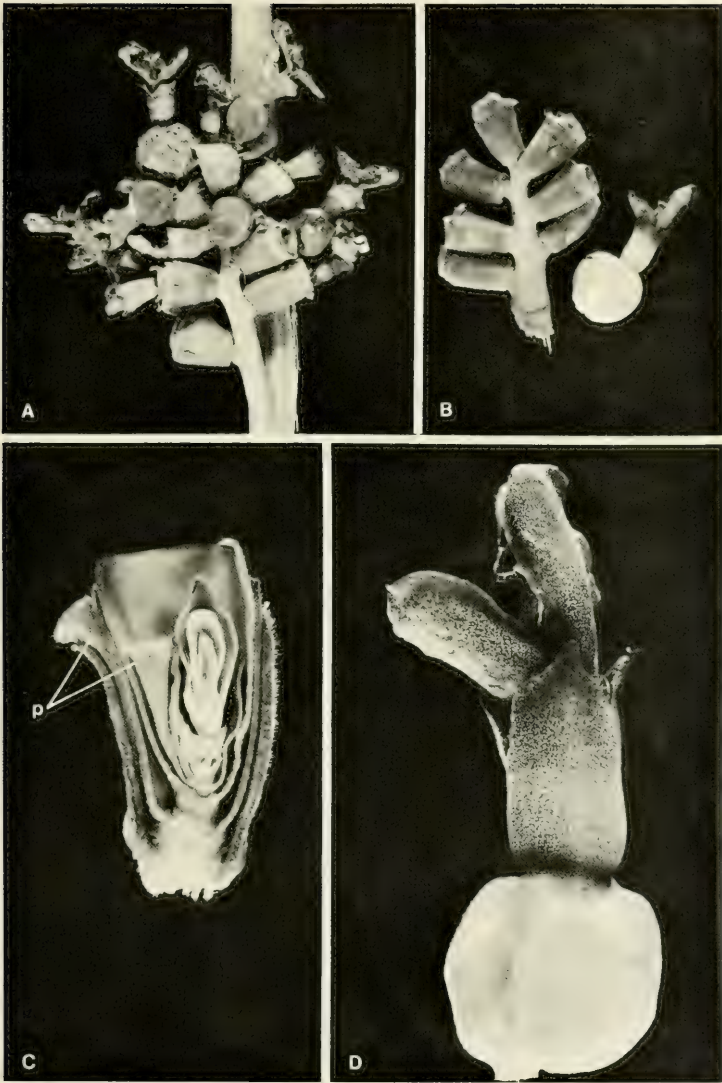
DISTRIBUTION: Endemic to Fiji; only the type and one additional collection have been noted.

LOCAL NAME: *Mboia*.

AVAILABLE COLLECTION: VITI LEVU: NAMOSI: Wainikoro Creek, *DA 16162*.

Alpinia horneana seems to be not strikingly different from *A. boia*, but the more cupuliform (less tubular) bracteoles and minor differences in bracteole indument and inner perianth glandulation probably make the species worth maintaining, at least at the present state of our knowledge.

FIGURE 53. *Alpinia horneana*, from *DA 16162*; A, a lateral inflorescence branch with eight cincinni, each with two or three telescoping bracteoles, some of which bear mature flowers projecting subterminally or laterally on short pedicels, $\times 1$; B, a lateral inflorescence branch with seven cincinni and a detached fruit with its persistent perianth, $\times 1$; C, longitudinal section of a cincinnus with three mature bracteoles, an inner fourth one encircling a young flower and a fifth bracteole with a flower bud, two pedicels (p) from which flowers have fallen being shown laterally to bracteoles, $\times 4$; D, flower with developing ovary, detached from pedicel, $\times 4$.





3. *Alpinia parksii* (Gillespie) A.C. Sm. in *Sargentia* 1: 7. 1942; J.W. Parham, Pl. Fiji Isl. 261. 1964, ed. 2. 354. 1972. FIGURE 54.

Langas parksii Gillespie in *Bishop Mus. Bull.* 91: 4, fig. 1. 1932.

This striking *Alpinia* occurs at elevations from near sea level to 930 m. in various types of forest. It is a coarse herb to 7 m. high, with leaf blades up to 1 m. long and a dependent inflorescence up to 1 m. long. Its bracteoles have been noted as green, its perianth segments as white, the inner ones becoming yellowish, its stamen and style as white, and its fruits pale or dull yellow and up to 25 × 15 mm. Flowers have been obtained between April and November, and fruits throughout the year.

TIPIFICATION: The holotype is *Parks 20379* (BISH), collected June 13, 1927, near Nakavu, on the Navua River, Namosi Province, Viti Levu (Nakavu is the only point where Namosi Province extends to the Navua River in its lower reaches; otherwise the river flows through Serua Province).

DISTRIBUTION: Endemic to Fiji and thus far known only from Viti Levu, Ovalau, Vanua Levu, and Taveuni.

LOCAL NAMES AND USE: *Lotholotho* is the most frequently used Fijian name, but *mboiamboa* has also been recorded. The leaves are sometimes used for thatching roofs.

AVAILABLE COLLECTIONS: VITI LEVU: NAMOSI: Wainikoro Creek, *DA 16161*. SERUA: Ngaloa Nature Reserve, *DA 16593*. NAITASIRI: Rarandawai, Wainamo-Wainisavulevu divide, Wainimala River Valley, *St. John 18270*; Tamavua Falls, *Tothill 886*. OVALAU: Hills east of Lovoni Valley, *Smith 7332*. VANUA LEVU: MATHUATA: Mt. Ndelaikoro, *DA 12816*. THAKAUNDROVE: Southern slope of Korotini Range, below Navitho Pass, *Smith 509*; Mt. Vatunivumonde, Savusavu Bay region, *Degener & Ordenez 14043*. TAVEUNI: Above Nggathavulo Estate, *DA 16906*.

This extraordinarily distinct species is at once recognized as different from *Alpinia hoia* by the elongate and well-separated lateral inflorescence branches and cincinni, by the much longer and essentially glabrous bracteoles, and by the long pedicels and outer perianth. Although the two species are sometimes essentially sympatric, in general one may notice that *A. parksii* replaces *A. hoia* as the observer progresses upward along ridges and slopes.

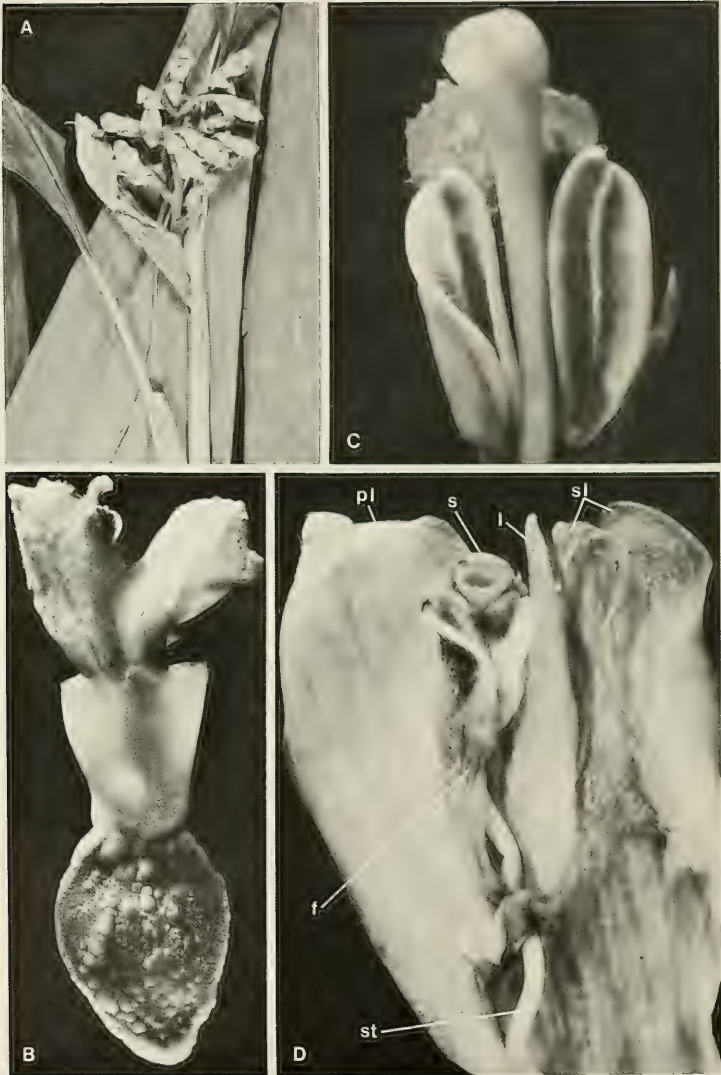
4. *Alpinia vitiensis* Seem. Fl. Vit. 290, pl. 87. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 315. 1892; K. Schum. in *Pflanzenr.* 20 (IV. 46): 319. 1904; J.W. Parham, Pl. Fiji Isl. 261. 1964, ed. 2. 354. 1972. FIGURE 55.

Alpinia sp. Seem. in *Bonplandia* 9: 260. 1861, Viti, 443. 1862.

This attractive, small species occurs at elevations of 150 to 1,030 m. in dense forest and dense crest thickets. It is an herb 0.5–2 m. high, the pseudostem being 1 cm. or less in diameter and bearing leaves distally and a terminal inflorescence up to 9 cm. in diameter but often smaller. The bracteoles are green, the outer perianth segments green with a white tube, the inner perianth segments white, and the fruits green to yellow or orange, up to 3 × 2 cm. Flowers and fruits have been obtained between May and December.

TIPIFICATION: The holotype is *Seemann 621* (K), noted on the specimen as collected at Somosomo, Taveuni (but probably obtained on May 30, 1860, when Seemann ascended to the old lake east of Somosomo).

FIGURE 54. *Alpinia parksii*: A, a lateral inflorescence branch with five cincinni, × 1/3; B, a cincinnus, with two laterally persistent fruits and a developing terminal flower, × 1; C, distal portion of flower, showing the posterior lobe (pl), the two smaller lobes (sl), the labellum (l), the anther (a) embracing the style, the stigma (s), and the base of a staminodial tooth (t), × 4; D, ovary (outer and inner perianth removed), epigynous glands, and base of style, × 10; A & B from *Smith 7332*, C & D from *DA 16906*.



DISTRIBUTION: Endemic to Fiji and thus far known only from Viti Levu, Vanua Levu, and Taveuni.

LOCAL NAMES: *Thevunga* and *vundivundi* have been recorded, but these names probably refer only to the family alliance.

AVAILABLE COLLECTIONS: VITI LEVU: NAITASIRI: Waimanu River, *DA 15806*; Tholo-i-suva, *DA 11885*. VANUA LEVU: THAKAUNDROVE: Mt. Mbatini, crest of range, *Smith 649*. TAVEUNI: Hills east of Somosomo, west of the old crater occupied by a small swamp and lake, *Smith 8373*, *DA 14370*, *15894*; above Nggathavulo Estate, *DA 16904*; western slope of Mt. Uluinalau, *DA 14080*. FIJI without further locality, *Horne 836*.

Alpinia vitiensis is quite unlike the other Fijian species of subgen. *Dieramalpinia* in its small stature, comparatively delicate facies, and compact, few-flowered inflorescence. Schumann erroneously placed it in his subgen. *Autalpinia* (i. e. subgen. *Alpinia*), apparently failing to notice the tubular bracteoles, which are not adequately illustrated in Seemann's otherwise excellent plate.

5. *Alpinia purpurata* (Vieill.) K. Schum. in *Pflanzenr.* **20** (IV. 46): 323. 1904; A. C. Sm. in *Sargentia* **1**: 7. 1942; Yunker in *Bishop Mus. Bull.* **178**: 40. 1943, in op. cit. **184**: 30. 1945; J. W. Parham in *Agr. J. Dept. Agr. Fiji* **29**: 31, as *A. purpuratum*. 1959, Pl. Fiji Isl. 261. 1964, ed. 2. 354. 1972; Sykes in *New Zealand Dept. Sci. Indust. Res. Bull.* **200**: 270. 1970; R. M. Sm. in *Notes Roy. Bot. Gard. Edinburgh* **34**: 153. fig. 1. 1975.

Guillainia purpurata Vieill. in *Bull. Soc. Linn. Normandie* **10**: 93 (repr. p. 4). 1866.

Alpinia purpurata var. *anomala* Gagnepain in *Christophersen in Bishop Mus. Bull.* **128**: 59. 1935; B. E. V. Parham in *New Zealand Dept. Sci. Indust. Res. Inform. Ser.* **85**: 125. 1972.

In Fiji this attractive species is known in cultivation, and it is also firmly naturalized in abandoned garden areas, along trails and streams in forest, and on the edges of mangrove swamps, at elevations up to 500 m. It is a coarse herb 1–3 m. high, with bright red or rich pink bracts; flowers are infrequent in Fiji, but these have the inner perianth segments white.

TIPIFICATION: The type is *Vieillard 1360* from New Caledonia (HOLOTYPE probably originally at CN, now transferred to P).

DISTRIBUTION: Although it is apparently indigenous in New Caledonia, the Solomon Islands, and the New Hebrides, this species is so widely cultivated as an ornamental and so abundantly naturalized from Thailand to Micronesia, Melanesia, and Polynesia that perhaps one should be cautious in indicating its place of origin. It was doubtless a very early (perhaps an aboriginal) introduction into Fiji. In cultivated or naturalized specimens the flowers are sometimes lacking or only partially developed.

LOCAL NAMES AND USES: *Thevunga*; *red ginger*. In addition to being an ornamental, the species is reputed to have unspecified medicinal uses.

AVAILABLE COLLECTIONS: VITI LEVU: NAITASIRI: Vicinity of Nasonggo, *Gillespie 4384*; between Waimanu River and Tongalevu, *DA 15449*; Nanduruloulou, *DA 12154*; Kalambo, *Bryan 217*. TAILEVU: Hills east of Wainimbuka River, near Ndakuivuna, *Smith 7216*. REWA: *Meebold 21414*; Suva Botanical Gardens, *DA 12336*; Suva, in private garden, *DA 16230*. KANDAVU: Namalata isthmus region, *Smith 8*. VANUA LEVU: MATHUATA: Southern base of Mathuata Range, north of Natua, *Smith 6827*.

FIGURE 55. *Alpinia vitiensis*, from *DA 16904*; A, inflorescence terminal on pseudostem, with portions of leaves, × 1; B, flower with developing ovary, × 4; C, anther, showing crest, staminodial teeth, locules with the style in position between them, and stigma, × 15; D, distal portion of opened inner perianth, showing the posterior lobe (pl), the two smaller lobes (sl), the labellum (l), the filament (f) bearing a staminodial tooth and the anther enfolded around the style (st), and the stigma (s), × 8.

Section *Guillainia*, as pointed out by R. M. Smith, belongs in subgen. *Dieramalpinia* rather than in subgen. *Autalpinia* (i. e. subgen. *Alpinia*), where Schumann incorrectly placed it.

6. *Alpinia vittata* Bull, Cat. 83: 4. 1873; R. M. Sm. in Notes Roy. Bot. Gard. Edinburgh 34: 170. 1975.

Alpinia sanderae Hort. ex Sander in Gard. Chron. III. 33: 245. pl. 1903; J. W. Parham, Pl. Fiji Isl. ed. 2. 354. 1972; B. E. V. Parham in New Zealand Dept. Sci. Indust. Res. Inform. Ser. 85: 23. 1972.

This cultivated plant is a coarse herb 2–3 m. high, with leaves up to 30 × 5 cm., the blades with white or yellow irregular streaks. The bracts are green and the inner perianth segments white. The only available Fijian specimen was flowering in March.

TIPIFICATION AND NOMENCLATURE: The species was introduced by Micholitz from New Ireland; no extant specimen of the type collection is known to R. M. Smith. The type of *Alpinia sanderae* was a cultivated plant exhibited at Ghent by Messrs. Sander & Sons, of St. Albans and Bruges, said to have come originally from New Guinea.

DISTRIBUTION: The original home of *Alpinia vittata* was doubtless somewhere in eastern Malesia or adjacent Melanesia, but it is known only from cultivated plants, some of them from tropical America.

USE: Ornamental.

AVAILABLE COLLECTION: VITI LEVU: REWA: Suva, in private garden, DA 16775. The taxon is doubtless more commonly grown in European gardens in and near Suva than this single collection would indicate.

Alpinia vittata, usually known as *A. sanderae*, is widely grown for its unusual, streaked leaves. As noted by R. M. Smith, it otherwise scarcely differs from *A. oceanica* Burkill (1896), probably indigenous in the Solomon Islands and perhaps in adjacent archipelagoes. *Alpinia vittata* may be merely a cultivar of *A. oceanica*, over which it has nomenclatural priority.

7. *Alpinia macrocephala* K. Schum. in Pflanzenr. 20 (IV. 46): 350. 1904; A. C. Sm. in J. Arnold Arb. 31: 148. 1950; J. W. Parham, Pl. Fiji Isl. 261. 1964, ed. 2. 354. 1972; R. M. Sm. in Notes Roy. Bot. Gard. Edinburgh 34: 172. 1975.

FIGURES 56, 57.

This remarkable species is a coarse herb 5–6 m. high, growing in dense forest at elevations of 150–1,300 m. Its leaves are up to 1.5 m. long and its inflorescence up to 20 cm. in diameter, with primary outer bracts as much as 15 × 8 cm. The perianth is white, the outer series and the bracteoles having a copious brown-sericeous indument; the stamen and style are also white, and the fruits are green, up to 3 × 2 cm. Flowers and fruits have been obtained in months scattered throughout the year.

TIPIFICATION: Schumann cites a Horne specimen (K) without number as the holotype. Actually this specimen, bearing Schumann's label, is *Horne 879*, collected in December, 1877 (and hence probably on Ovalau), with Horne's notation: "Com-

FIGURE 56. *Alpinia macrocephala*; A, exterior surface of maturing inflorescence, × 1/2; B, longitudinal section of maturing inflorescence, × 1/2; C, a cincinnus enclosed by its outermost bracteole, × 1; D, young flower, with the labellum protruding from the developing inner perianth segments, × 2; E, distal portion of opened inner perianth, showing the posterior lobe (pl), the two smaller lobes (sl), the labellum (l), the filament (f) and anther (a) embracing the style, and the stigma (s), × 2; A–C from *Smith 5873*, D & E from *DA 16883*.

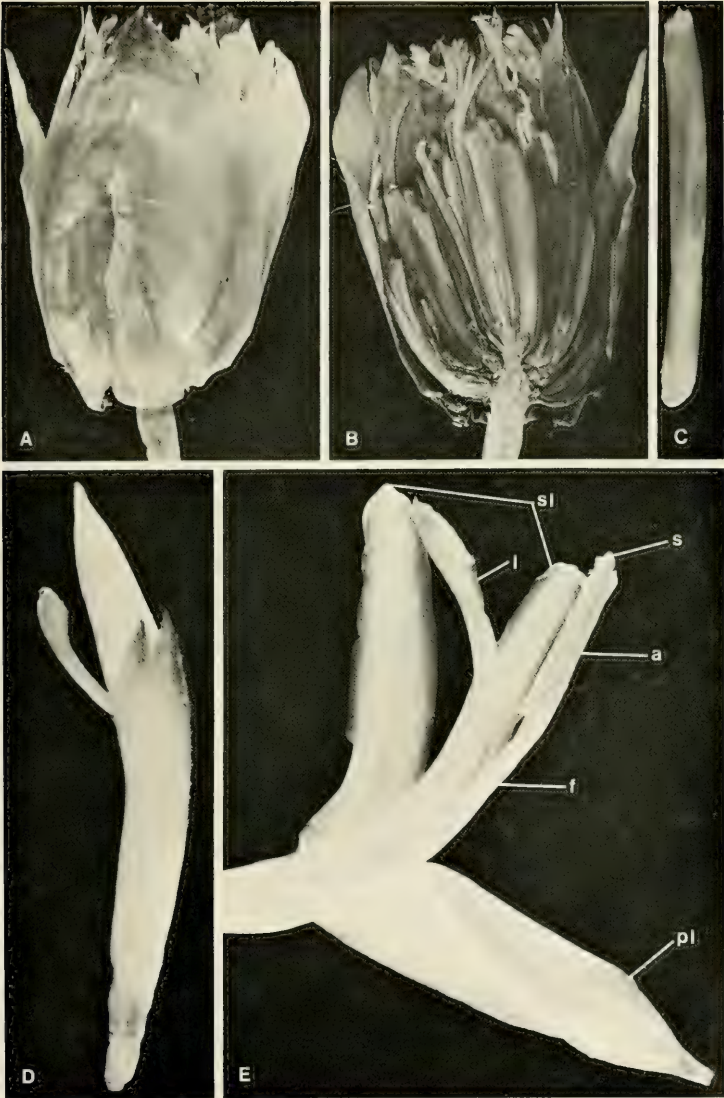




FIGURE 57. *Alpinia macrocephala*, from DA 16883; A, distal portion of flower, showing labellum, style and stigma, filament with staminodial teeth, and anther, $\times 4$; B, ovary with perianth removed, showing epigynous glands and base of style, $\times 10$.

mon in many parts of the mountain forests in Fiji, especially in hollows where the soil is damp & rich. 16–18 ft. high.”

DISTRIBUTION: Endemic to Fiji and known from comparatively few collections; it may be more common than suggested, but the large inflorescences are saturated with water and are probably discouraging to collectors.

LOCAL NAMES: *Mboia*; *loholotho*.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Hills between Nggaliwana and Tumbeindreketi Creeks, east of the sawmill at Navai, *Smith 5873*; near summit of Mt. Tomanivi, *Gillespie 4097*. OVALAU: *U.S. Expl. Exped.*; hills east of Lovoni Valley, *Smith 7334*. VANUA LEVU: THAKAUNDROVE: Navonu Ridge, west of Mbutha Bay, Natewa Peninsula, *DA 16883*. TAVEUNI: Trail above Somosomo, *Gillespie 4829*.

8. *Alpinia zerumbet* (Pers.) Burt. & R. M. Sm. in Notes Roy. Bot. Gard. Edinburgh 31: 204. fig. 10. 1972.

Zerumbet speciosum Wendl. in Schrader & Wendl. Sertum Hannover. 4: 3. t. 19 (err. 18). 1798.
Costus zerumbet Pers. Syn. Pl. 1: 3. 1805.

Alpinia speciosa sensu K. Schum. in K. Schum. & Holtr. Fl. Kais. Wilhelmsl. 29. 1889; K. Schum. in Pflanzenr. 20 (IV. 46): 339. fig. 40, D-F. 1904; Yuncker in Bishop Mus. Bull. 178: 40. 1943; Sykes in New Zealand Dept. Sci. Indust. Res. Bull. 200: 270. 1970; non D. Dietr. (1839).

Alpinia nutans sensu K. Schum. in K. Schum. & Holtr. Fl. Kais. Wilhelmsl. 28. 1889; J. W. Parham in Agr. J. Dept. Agr. Fiji 29: 31. 1959, Pl. Fiji Isl. 261. 1964; B. E. V. Parham in New Zealand Dept. Sci. Indust. Res. Inform. Ser. 85: 21. 1972; non Roscoe (1805).

Catumbium speciosum Holttum in Gard. Bull. Singapore 13: 152. 1950; J. W. Parham, Pl. Fiji Isl. ed. 2. 355. 1972.

In Fiji this well-known plant is cultivated or perhaps sparsely naturalized along roadsides near sea level. It is a coarse herb 2-4 m. high with a nodding inflorescence; the bracteoles are white with pink tips; the lobes of the inner perianth segments are white, tipped with red or pink; the labellum is yellow marked with red within, and the fruits are subglobose and red. Flowers in Fiji have been noted between January and March.

TYPIFICATION AND NOMENCLATURE: The complicated synonymy of this widely cultivated species is discussed by Burtt and Smith in their publication of the correct binomial; it has most often passed as *Alpinia speciosa* or *A. nutans*. The oldest applicable binomial is *Zerumbet speciosum*, which Wendland typified as: "China. In Caldario adseruari debet." If there is an extant type it is probably at GOET, but Wendland's illustration would serve as an adequate type. The epithet *speciosa* is not available for this plant in *Alpinia* because of the older *A. speciosa* (Bl.) D. Dietr., based on *Elettaria speciosa* Bl. (1827) (= *Nicolaia elatior* (Jack) Horan.). Persoon wished to transfer Wendland's taxon to *Costus* but could not adopt the epithet because of the earlier *C. speciosus* (König) Sm. (1791); he therefore called the taxon *Costus zerumbet*, thus providing the earliest epithet available for this taxon in *Alpinia*. The epithet *nutans* refers to a different taxon, *Alpinia nutans* (L.) Roscoe (1805), based on *Globba nutans* L. (1771); cf. R. M. Sm. in Notes Roy. Bot. Gard. Edinburgh 34: 160. 1975.

DISTRIBUTION: The species is probably indigenous in New Guinea or some neighboring part of eastern Malesia, but it has long been in cultivation and now occurs in most tropical countries. It was probably an early (but not aboriginal) introduction into Fiji.

LOCAL NAME AND USE: *Shell ginger*. Ornamental.

AVAILABLE COLLECTIONS: VITI LEVU: NAITASIRE: Koronivia, DA 12360. REWA: Suva, in private garden, DA 16085. VANUA LEVU: THAKAUNDROVE: Along Hibiscus Highway east of Savusavu, Bierhorst F172. These collections do not give an adequate sample, as the species occurs in many Fijian gardens.

9. *Alpinia mutica* Roxb. in Asiat. Res. 11: 354. 1810; K. Schum. in Pflanzenr. 20 (IV. 46): 327. 1904; Burtt & R. M. Sm. in Notes Roy. Bot. Gard. Edinburgh 31: 308. 1972; B. E. V. Parham in New Zealand Dept. Sci. Indust. Res. Inform. Ser. 85: 21. 1972.

Catumbium muticum Holttum in Gard. Bull. Singapore 13: 150. fig. 17. 1950; J. W. Parham, Pl. Fiji Isl. ed. 2. 355. 1972.

This ornamental species, known only in cultivation in Fiji, occurs there at elevations up to 100 m. It is a coarse herb 1-2.5 m. high with a suberect inflorescence. The inner perianth segments are white; the labellum is yellow, spotted in the basal half and apically veined with crimson; the filament is white with a pink tinge and the anther yellowish; the orange-red fruits are 1.5-2 cm. in diameter.

TYPIFICATION: The type was a cultivated plant in the Calcutta Botanic Garden, apparently originally found by Roxburgh in the forests of Penang.

DISTRIBUTION: From its place of origin in Malesia this species has now become widespread in cultivation. It is more frequent in Fiji than suggested below.

LOCAL NAMES AND USE: *Thevunga* has been recorded in Fiji, but the usual common names are *small shell ginger* or *orchid ginger*. Ornamental.

AVAILABLE COLLECTIONS: VITI LEVU: NAITASIRI: Nanduruloulou, *DA 12157*. TAILEVU: Mburekalou, Vungalei, *DA 5668*.

FAMILY 30. CANNACEAE

CANNACEAE Juss. Gen. Pl. 62, as *Cannae*. 1789.

Often robust, perennial, glabrous herbs with fleshy sympodially branched rhizomes bearing distichous scale leaves, each rhizome segment ending in a leafy shoot; aerial shoots with a well-developed stem and leaves distichously arranged, the proximal ones represented by bladeless sheaths, the distal ones with penninerved blades, the ligule lacking; inflorescence terminal on a leafy shoot, spicate, racemiform, or paniculate, with usually 2-flowered cincinni; flowers ♀, zygomorphic; perianth segments 6, the 3 outer ones calycine, imbricate, free, erect, persistent, the 3 inner ones corolline, proximally connate and adnate to the androecium, yellow to red; staminodes usually 3, sometimes 1–4, recurved, broad, the innermost (labellum) the smallest; fertile stamen 1, the filament recurved, flat, the anther 1-locular; ovary inferior, papillose, 3-locular, the ovules numerous, anatropous, in 2 rows on axile placentas, the style flat, petaloid, proximally adnate to filament, the stigma terminal; fruit a loculicidally 3-valved capsule, often verrucose, the seeds comparatively few, subglobose, with hard endosperm.

DISTRIBUTION: One genus in tropical America with about 55 species, now found throughout the tropics, with many hybrids cultivated there and in temperate countries.

1. *CANNA* L. Sp. Pl. 1. 1753; Seem. Fl. Vit. 292. 1868; Kraenzl. in Pflanzenr. 56 (IV. 47): 27. 1912; Winkler in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. 15a: 652. 1930.

Characters of the family.

LECTOTYPE SPECIES: *Canna indica* L. (vide Britton, Fl. Bermuda, 86. 1918), one of Linnaeus's three original species.

DISTRIBUTION: As of the family.

1. *Canna indica* L. Sp. Pl. 1. 1753; Seem. in Bonplandia 9: 260. 1861, Viti, 443. 1862, Fl. Vit. 292. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 315. 1892; Kraenzl. in Pflanzenr. 56 (IV. 47): 59. fig. 8, A–C. 1912; Winkler in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. 15a: 654. fig. 293, A, B. 1930; Christophersen in Bishop Mus. Bull. 128: 60. 1935; Greenwood in J. Arnold Arb. 25: 402. 1944; Yunker in Bishop Mus. Bull. 220: 86. 1959; J. W. Parham in Dept. Agr. Fiji Bull. 35: 142. 1959, Pl. Fiji Isl. 262. 1964, ed. 2. 356. 1972; Sykes in New Zealand Dept. Sci. Indust. Res. Bull. 200: 224. 1970; B. E. V. Parham in New Zealand Dept. Sci. Indust. Res. Inform. Ser. 85: 22. 1972; St. John in Phytologia 36: 368. 1977.

This distinctive plant is naturalized and often frequent around villages, along roadsides, in coconut plantations, in clearings, and in forest near streams, at elevations from near sea level to 450 m. It is a coarse herb to 2.5 m. high, the leaves sometimes with purple sheaths, midrib, and margins; the inner perianth segments are yellow to orange-red or red; the staminodes and labellum are red; the fruits are green, becoming reddish brown at maturity, with black seeds. Flowers and fruits are found at all seasons.

TYPIFICATION: Linnaeus gave several prior references and noted: "*Habitat inter tropicos Asiae, Africae, Americae.*"

DISTRIBUTION: Although indigenous in tropical America, *Canna indica* has attained a wide distribution throughout the tropics. Many horticultural forms are cultivated, some of them doubtless hybrids involving other species.

LOCAL NAMES AND USE: *Ngasau ni nga; canna; wild canna; red canna; Indian shot* (the last of these was mentioned by Seemann as the name used by the European colonists of his period). It is difficult to say whether this plant is a naturally occurring adventive or whether it has developed from an introduced ornamental. As an ornamental, the large-flowered form is grown in villages and gardens, although the only available herbarium voucher for it is *DA 16086*, from a private garden in Suva.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Lautoka, *Greenwood 149*. NANDRONGA & NAVOSA: Upper Singatoka Valley, *DA 11357*; near Tonuve, *H. B. R. Parham 192*. NAMOSI: Vicinity of Namosi, *Gillespie 2813*. NAITASIRE: Prince's Road, *DA 16942*; Nasinu, *DA 11205*. KANDAVU: Western end of island near Cape Washington, *Smith 301*. OVALAU: Valley of Mbureta and Lovoni Rivers, *Smith 7497*. NGAU: *Milne 148*. VANUA LEVU: THAKAUNDROVE: Near Tukavesi, Mbutha Bay, *DA 16872, 16873*. TAVEUNI: *Seemann 625*. VANUA MBALAVU: Near Lomaloma, *DA 10222*. LAKEMBA: Near Tumbou, *Garnock-Jones 886*. MOTHE: Central high peak, *Bryan 476*.

It seems very likely that all the Fijian material of *Canna* belongs in *C. indica*; the flowers I have examined have three staminodes in addition to the labellum and hence in Kraenzlin's system the taxon belongs in subgen. *Canna* sect. *Trialatae*. *Canna humilis* Bouché, recorded from Samoa, has only two staminodes and hence belongs in sect. *Bialatae*; neither it nor the several other species recorded from Polynesia have been observed in Fiji.

FAMILY 31. MARANTACEAE

MARANTACEAE Petersen in Engl. & Prantl, Nat. Pflanzenfam. II. 6: 33. 1888.

Nonaromatic, perennial herbs with sympodially branched rhizomes bearing erect shoots, these complexly branched or reduced; leaves 2-ranked, with an open sheath, the petiole with a distal pulvinus, the blade rolled in bud, penninerved, the halves unequal in size; inflorescence terminal on leafy or leafless shoots, forming a compound spike, head, or panicle; flowers $\bar{\sigma}$, zygomorphic, usually in pairs and in the axils of bracts; perianth segments 6, the 3 outer ones free, usually small, the 3 inner ones proximally connate into a long or short tube and adnate to the androecium; staminodes 3 or 4, often petaloid; fertile stamen 1, often petaloid, the anther 1-locular; ovary inferior, usually 3-locular, sometimes 1-locular, the ovules solitary in each locule, erect from base, the style curved, at first enveloped by a cucullate staminode, involute or dilated at apex, the stigma 3-lobed; fruit fleshy or a loculicidal capsule, the seeds 1-3, arillate, with abundant endosperm.

DISTRIBUTION: Tropical, with about 30 genera and 400-500 species, and with a major center of distribution in America. Three genera, all cultivated, are recorded from Fiji.

KEY TO GENERA

Ovary 3-locular, with 3 ovules; stem short, the leaves mostly radical. 1. *Calathea*
Ovary 1-locular, with 1 ovule; stem more or less branched, the leaves both radical and cauline.

Leaf blades homotropous (i.e. all those of the plant with either the right or the left side the larger).

2. *Maranta*

Leaf blades antitropous (i. e. those of one side of the plant with the right side the larger, those of the other side with the left side the larger). 3. *Stromanthe*

1. *CALATHEA* G.F.W. Meyer, Prim. Fl. Esseq. 6. 1818; K. Schum. in Pflanzenr. **11** (IV. 48): 69. 1902; Loesener in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. **15a**: 675. 1930.

Small, erect herbs, with usually unbranched stems; leaves mostly radical, the blades often ornamentally colored; inflorescence spiciform or capitate; outer perianth segments equal or subequal, the inner perianth segments forming a narrow tube; outer staminode 1, rarely absent; ovary 3-locular, 3-ovuled; fruit dehiscent, the seeds 1-3, the aril 2-lobed.

TYPE SPECIES: *Calathea discolor* G.F.W. Meyer, the only original species; this may be identical with *C. lutea* (Aubl.), based on *Maranta lutea* Aubl., but the combination, often ascribed to Meyer, was not made by him in 1818.

DISTRIBUTION: Tropical America including the West Indies, with about 150 species. One species, known only in cultivation, has been recorded from Fiji.

1. *Calathea lindeniana* Wallis in Hort. Belge **16**: 200. 1866; K. Schum. in Pflanzenr. **11** (IV. 48): 97. 1902; J. W. Parham, Pl. Fiji Isl. 263. 1964, ed. 2. 356. 1972.

Calathea lindenii Wallis & André in Ill. Hort. **18**: 211. pl. 82. 1871.

Infrequently cultivated near sea level in Fiji, this species is a coarse herb about 1 m. high, with dark green leaf blades that are olive-green along the midrib; the inner perianth segments and staminodes are yellow.

TIPIFICATION: The species is based on a cultivated plant, presumably derived from material first discovered by G. Wallis along the Río Huallaga in Peru, introduced by Linden in 1866 in Brussels.

DISTRIBUTION: South America; occasionally cultivated elsewhere. No herbarium vouchers support the record, but Parham indicates that the species was introduced into Fiji in the 1880's.

USE: Ornamental.

2. *MARANTA* L. Sp. Pl. 2. 1753; K. Schum. in Pflanzenr. **11** (IV. 48): 123. 1902; Loesener in Engl. & Prantl, Nat. Pflanzenr. ed. 2. **15a**: 681. 1930.

Erect herbs with branched and zigzag stems; leaves radical and cauline, the blades homotropous; inflorescence slender, several-times forked, the rachises spiciform, few-flowered, the peduncles of each flower-pair unequal in length; outer perianth segments equal, the inner perianth segments with equal lobes; outer staminodes 2, petaloid; ovary 1-locular; fruit indehiscent, the seed with a small aril.

TYPE SPECIES: *Maranta arundinacea* L., the only original species.

DISTRIBUTION: Tropical America, with about 25 species. A single cultivated species has been recorded from Fiji.

1. *Maranta arundinacea* L. Sp. Pl. 2. 1753; K. Schum. in Pflanzenr. **11** (IV. 48): 125. fig. 16. 1902; Loesener in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. **15a**: 682. fig. 308. 1930; Christophersen in Bishop Mus. Bull. **128**: 60. 1935; Yuncker in op. cit. **220**: 86. 1959; J. W. Parham, Pl. Fiji Isl. 263. 1964, ed. 2. 356. 1972; B. E. V. Parham in New Zealand Dept. Sci. Indust. Res. Inform. Ser. **85**: 77. 1972.

Infrequently cultivated near sea level in Fiji, this species is a slender, erect herb about 1 m. high, with white inner perianth segments.

TIPIFICATION: Following prior citations, Linnaeus indicates: "*Habitat in America calidiore.*"

DISTRIBUTION: Schumann believes the species to be from Guiana and western Brazil, and perhaps also from Mexico; it is now widely cultivated and has become

naturalized in many Pacific archipelagoes, although this is not noted in Fiji. J. W. Parham considers it an early introduction; no herbarium vouchers have been seen.

LOCAL NAMES AND USES: *Yambia ni vavalangi*; arrowroot. Ornamental. The fine-grained starch extracted from the rhizomes is the source of the "West Indian arrowroot." This starch, however, is not used in Fiji, where the genus *Tacca* is used for the same purposes. An interesting account of the plant is found in J. W. Purseglove, *Tropical Crops: Monocotyledons*, 336-342, 1972.

3. *Stromanthe* Sonder in Neue Allg. Deutsche Gart. Blumenzeit. 5: 225. 1849; K. Schum. in Pflanzenr. 11 (IV. 48): 145. 1902; Loesener in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. 15a: 686. 1930.

Coarse herbs; leaf blades antitropous; inflorescence paniculiform, the bracts dorsiventral, colored; ovary 1-locular.

TYPE SPECIES: *Stromanthe sanguinea* Sonder.

DISTRIBUTION: Tropical America, with about 13 species. A single cultivated species has been recorded from Fiji.

1. *Stromanthe sanguinea* Sonder in Neue Allg. Deutsche Gart. Blumenzeit. 5: 225. 1849; K. Schum. in Pflanzenr. 11 (IV. 48): 148. fig. 18. 1902; Loesener in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. 15a: 687. fig. 310. 1930.; J. W. Parham, Pl. Fiji Isl. 263. 1964, ed. 2. 356. 1972.

Infrequently cultivated near sea level in Fiji, this species is a coarse herb about 1 m. high; the leaf blades are reddish purple beneath, the flowering panicle and bracts are red, and the inner perianth segments are white.

TYPIIFICATION: The species is based on a cultivated plant said to have come from the East Indies, although its ultimate origin was doubtless tropical America.

DISTRIBUTION: Schumann indicates the species as indigenous in Brazil; it is now widespread in cultivation. I have seen no herbarium material to support the Fijian record, but the species is unmistakable.

USE: Ornamental.

ORDER ORCHIDALES

FAMILY 32. ORCHIDACEAE

The manuscript for the family Orchidaceae, by Peter F. Hunt, was not completed in time for inclusion in this first volume. It will be printed out of sequence in a subsequent volume.

SUBCLASS COMMELINIDAE

KEY TO ORDERS OCCURRING IN FIJI

Flowers with a perianth (in Cyperales this reduced to scales, bristles, or hairs, sometimes absent, this order otherwise differing from Poales in having the flowers usually spirally arranged and each subtended by a single bract, the stems usually solid and triquetrous, the leaves rarely ligulate).

Perianth reduced to scales, bristles, or hairs, sometimes absent, the flowers in spikelets and usually solitary, subtended by a single bract and usually spirally arranged; stamens usually 1-3; ovary superior, 1-locular, with a single anatropous ovule erect from base, the stigmas usually 3, less often 2; fruit nutlike, indehiscent, the seed erect, the embryo embedded in abundant endosperm; stems usually solid (rarely hollow) and triquetrous; leaves very rarely ligulate.

CYPERALES (FAMILY 33)

Perianth (in our families) obvious and biseriate.

Outer and inner series of perianth distinctly dissimilar; flowers mostly pollinated by insects, sometimes by birds.

Plants terrestrial or epiphytic, often xerophytic; flowers with sepal or sepal-derived nectaries, arranged in a terminal inflorescence often with colored bracts; inner perianth segments corolline; stamens 6; ovary inferior (rarely superior), the ovules numerous in each ovary locule; fruit usually fleshy and indehiscent. BROMELIALES (FAMILY 34)

Plants usually with jointed and succulent stems; flowers without nectaries or nectar, the inflorescence composed of variously arranged cincinni; inner perianth segments mostly free; fertile stamens 6 or 3 (or 1); ovary superior, the ovules few to solitary in each ovary locule; fruit (in our family) usually a thin-walled loculicidally dehiscent capsule.

COMMELINALES (FAMILY 35)

Outer and inner series of perianth somewhat similar, the segments imbricate, dry; flowers (in our families) wind-pollinated, in terminal panicles; stamens 6, hypogynous; ovary superior, 3-locular, each locule with a solitary, orthotropous ovule spreading or pendulous from an axile placenta; fruit indehiscent, the seeds with copious endosperm; stems erect or climbing, the leaf blades elongate, sometimes terminating in a tendril. RESTIONALES (FAMILIES 36, 37)

Flowers without a perianth (or with 2 or 3 minute hyaline or fleshy scales sometimes interpreted as a perianth), subsessile between 2 bracts (a lower palea or lemma and an upper palea), the whole forming a floret or false flower, these 1-many, distichous (if more than 1) and sessile on a short axis (rachilla) bearing at base 2 empty bracts (upper and lower glume); florets and glumes forming a spikelet, these variously arranged to form an inflorescence; stamens 1-6 or more but usually 3, hypogynous; ovary 1-locular, with a single often orthotropous ovule often adnate to its adaxial side or pendulous; stigmas usually 2, rarely 3, the styles usually free; fruit usually a caryopsis with a thin pericarp adnate to seed, the embryo peripheral to endosperm; stems cylindrical (rarely flattened), with well-marked solid nodes and usually hollow internodes; ligule present at junction of leaf sheath and blade. POALES (FAMILY 38)

ORDER CYPERALES

FAMILY 33. CYPERACEAE

BY TETSUO KOYAMA

(The New York Botanical Garden)

CYPERACEAE Juss. Gen. Pl. 26, as *Cyperoideae*. 1789.

Grasslike or rushlike annuals or perennials, sometimes monoecious, rarely dioecious, often with rhizomes or stolons; stems (culms) scapelike or nodose and bearing leaves at nodes, usually 3-sided and solid; leaves radical and/or cauline, with linear or more rarely lanceolate blades or reduced to subaphyllous sheaths; ligules usually none or very short, but ventral side of leaf sheaths sometimes projected beyond sheath orifice forming a tongue-like appendage (contra-ligule); inflorescences variable, mostly corymbose, paniculate, or spicate, sometimes reduced to a single spikelet, the primary bracts as a rule leaflike; spikelets bearing glumes imbricated or 2-ranked on a continuous axis (rachilla), all or few of the glumes flower-bearing; flowers hermaphrodite or unisexual, without perianth, with 3 to many hypogynous bristles; stamens usually 1-3; pistils usually 2- or 3-carpellate, the style elongated or short, continuous with or jointed with ovary, sometimes enlarged and spongy at base, at apex usually 2- or 3-cleft, forming stigmas; fruit an achene.

DISTRIBUTION: The Cyperaceae, one of the largest families of monocotyledons, contain well over 5,000 species, with the highest generic concentration in tropical South America. In the present treatment I recognize 18 genera and 44 species as occurring in Fiji. In some cases it is difficult to be certain whether a given species is indigenous or adventive, but in my opinion there are in Fiji 24 indigenous species (of which three are endemic) and 20 adventive species (of which two are escapes from cultivation). The three endemics are *Mapania vitiensis*, *Gahnia vitiensis*, and *Carex gibbsiae*.

USEFUL TREATMENTS OF FAMILY: Koyama, T. Classification of the family Cyperaceae. J. Fac. Sci. Univ. Tokyo, Sect. 3, Bot. **8**: 37-148. 1961, 149-278. 1962. Koyama, T. The Cyperaceae of Micronesia. Micronesia **1**: 59-111. 1964. Blake, S.T. Studies in Cyperaceae. Contr. Queensland Herb. **8**: 1-48. 1969. Koyama, T. Delimitation and classification of the Cyperaceae-Mapanioideae. In: Gunkel, J.E. Current Topics in Plant Science, 201-228. 1969. Kern, J.H. Cyperaceae. Fl. Males. **1**: 7: 435-753. 1974.

ARTIFICIAL KEY TO GENERA

Pistillate flowers terminal, always only 1 to a spikelet.

Spikelets bisexual, with 1 terminal pistillate flower and more than 2 axillary staminate flowers; fruits with thick, spongy mesocarp.

Leaves with grasslike blades; inflorescences corymbose with many spikes; bracts leafy.

Spikelets with small hyaline glumes (usually termed "squameae") between prophylls and pistillate flower.

Squamellae many, up to 12 per spikelet. 1. *Scirpodendron*

Squamellae 4-6 per spikelet. 2. *Mapania*

Spikelets without hyaline glumes ("squameae") between prophylls and pistillate flower.

3. *Hypolytrum*

Leaves reduced to bladeless sheaths; inflorescences composed of single pseudolateral spikes subtended by culmlike bracts. 4. *Lepironia*

Spikelets unisexual (rarely bisexual but this condition not applicable to Fijian species); achenes bony, with thick, hard endocarps. 5. *Scleria*

Pistillate or fruit-bearing flowers lateral and axillary, 1-several to a spikelet, the flowers usually hermaphrodite, rarely unisexual.

Flowers as a rule hermaphrodite, the fruit-bearing ones subtended by a glume only.

Glumes within a spikelet essentially similar; fruit a true achene without an unusually thick endocarp.

Spikelet with all the glumes flower-bearing; glumes of the basal part of a spikelet larger than or as large as those of the middle part; all flowers as a rule hermaphrodite.

Glumes spirally imbricate (exception: *Fimbristylis ovata*, in which most glumes are irregularly 2-ranked).

Base of style not markedly enlarged, continuing down to achene apex without clear demarcation. 6. *Schoenoplectus*

Base of style spongy-thickened, showing a clear demarcation between style and achene.

Style base persistent at apex of achene, hence the remaining part of style breaking off from style base. 7. *Eleocharis*

Style base jointed at base, falling off apart from mature achene. 8. *Fimbristylis*

Glumes 2-ranked.

Achenes 3-sided with one of the sides facing the rhachilla.

Rhachilla not jointed; glumes falling individually; rhachilla more or less persistent.

9. *Cyperus*

Rhachilla jointed either at base or both at base and at all nodes.

Rhachilla jointed only at base; spikelets falling entire apart from rhachis of spike.

10. *Mariscus*

Rhachilla jointed both at base and at nodes, breaking up into individual internodes, each of which falls off with its glume. 11. *Torulinum*

Achenes lenticular with one of the edges facing the rhachilla. 12. *Pycnus*

Spikelet with only a few of the glumes flower-bearing.

Style continuing down to apex of achene, not showing clear demarcation between style and achene.

Achenes lenticular with one of the edges facing the rhachilla; spikelets laterally flattened; glumes hyaline. 13. *Kyllinga*

Achenes 3-sided with one of the sides facing the rhachilla; spikelets turgid; glumes chartaceous. 14. *Machaerina*

Style with either markedly thickened style base or clearly jointed at very base, showing clear demarcation between style and achene.

Achenes 3-sided, not crowned with spongy style base; style 3-sided, falling apart from mature achene. 15. *Schoenus*

Achenes lenticular, crowned by spongy-thickened style base, this persistent on mature achene. 16. *Rhynchospora*

Glumes within a spikelet dimorphous, i. e. the flower-bearing distal glumes obtuse-tipped and much shorter than the lower, awned, empty glumes; fruit with a thick, hard endocarp; spikelets 1-fruited in Fijian species. 17. *Gahnia*

Flowers unisexual; pistillate flower enclosed in a bottle-shaped structure (utricle), exposing only its stigmas from the small orifice of the utricle. 18. *Carex*

SYNOPSIS OF GENERA IN FIJI

Modified from Koyama, 1961, 1962, and 1969

(See Useful treatments of family, above)

Subfamily 1. Mapanioideae. Pistillate flowers terminal; spikelets compound.

Tribe 1. Mapanieae. Spikelets bisexual, with indeterminate axis, compound with glumes bearing a bisexual cymule; fruits with thick, spongy mesocarp.

1. *Scirpodendron* Zipp. ex Kurz2. *Mapania* Aubl.3. *Hypolytrum* L. C. Rich.4. *Lepironia* L. C. Rich.

Tribe 2. Sclerieae. Spikelets unisexual or bisexual, the pistillate and bisexual ones terminated by a pistillate flower; fruits with thick, bony endocarp.

5. *Scleria* Bergius

Subfamily 2. Cyperioideae. Flowers (synanthia) usually hermaphrodite, lateral and axillary; fruits true achenes.

Tribe 3. Scirpeae. Glumes spirally imbricate, all flower-bearing; flowers often with hypogynous bristles.

6. *Schoenoplectus* Palla7. *Eleocharis* R. Br.8. *Fimbristylis* Vahl

Tribe 4. Cyperae. Glumes 2-ranked, all flower-bearing; flowers without hypogynous bristles.

9. *Cyperus* L.10. *Mariscus* Vahl11. *Torulinum* Desv. ex Hamilton12. *Pycnus* Beauv.13. *Kyllinga* Rottb.

Tribe 5. Rhynchosporae. Glumes imbricate or 2-ranked, only one to a few of them flower-bearing; flowers usually with hypogynous bristles.

14. *Machaerina* Vahl15. *Schoenus* L.16. *Rhynchospora* Vahl17. *Gahnia* J. R. & G. Forst.

Subfamily 3. Caricoideae. Flowers not in synanthia, unisexual; plants sometimes dioecious; pistillate flowers surrounded by an open or closed saclike prophyll; pistillate spikelets in most cases reduced to a utricle.

18. *Carex* L.1. *Scirpodendron* Zipp. ex Kurz in J. Asiat. Soc. Bengal 38 (2): 84. 1869.

Robust perennial herb with low central culm and many elongated leaves much surpassing the culm; inflorescence a terminal contracted panicle, usually lobed with short branches, bearing many spikelets spicately disposed on branchlets; spikes sessile with many spirally arranged glumes each subtending an axillary spikelet; spikelets bisexual, each terminated by a naked pistillate flower, bearing up to 12 lateral monandrous staminate flowers each subtended by a hyaline small scale, only the lowest pair of small scales with a pronounced keel; pistil tristigmatic, developing a large fruit with several irregular ridges of spongy mesocarp tissue.

TYPE SPECIES: *Scirpodendron costatum* Kurz, the only original species (not based on *Pandanophyllum costatum* Thw., which is questioned as a possible synonym) (= *S. ghaeri* (Gaertn.) Merr.).

DISTRIBUTION: A monotypic genus occurring from Ceylon through Malesia and eastward to northern Australia, Micronesia, and Samoa.

1. *Scirpodendron ghaeri* (Gaertn.) Merr. in Philipp. J. Sci. Bot. 9: 268. 1914; A. C. Sm. in Bull. Torrey Bot. Club 70: 534. 1943; S. T. Blake in Proc. Roy. Soc. Queensland 54: 73. 1943; T. Koyama in Micronesica 1: 63. 1964; J. W. Parham, Pl. Fiji Isl. 299. 1964, ed. 2. 394. 1972. FIGURE 58.

Chionanthus ghaeri Gaertn. Fruct. Sem. Pl. 1: 190. pl. 39, fig. a-e. 1788.

Hypolytrum costatum Thw. Enum. Pl. Zeyl. 346. 1864.

Scirpodendron costatum Kurz in J. Asiat. Soc. Bengal 38 (2): 85. 1869; J. W. Parham in Dept. Agr. Fiji Bull. 35: 154. 1959.



FIGURE 58. *Scirpodendron ghaeri*, from Degener & Ordonez 14249; A, habit, $\times 1/2$; B-D, fruits, $\times 2.5$. The 1 cm. scale applies to fruits.

Coarse but low perennial with woody rhizome; culm solitary, central, 25–35 cm. tall; leaves many, basal and subbasal, the blades resembling those of *Pandanus*, much surpassing the culm, 100–230 cm. long, 2–5 cm. broad, coriaceous, prominently serrulate-scabrous on margins, the sheaths dark purplish brown; inflorescence ovoid or ellipsoid in outline, 6–15 cm. long, 3–5 cm. broad, more or less lobed, congested, the partial inflorescences 3–8, each subtended by an elongated leafy bract up to 90 cm. long; flowering spikelets ovoid, 1–2 cm. \times 5–9 mm. in size, 6–12 cm. \times 5–8 cm. with fruits; glumes ovate, 6–8 mm. long, membranous, subacute at apex; fruits somewhat drupelike, 8–16 mm. long, 6–11 mm. broad, generally rhombic-obovate, prominently to weakly 6–10-ridged, the fleshy skin 0.7–1 mm. thick, the contained achene 7–8 mm. long; style twice as long as fruit body, 3-fid at apex.

TIPIFICATION AND NOMENCLATURE: The type locality of both basionyms concerned is Ceylon, where this historical sedge had been collected as early as 1758. The first collection, however, consisted of fruits only. These fruits, labelled as *gierietette*, were brought to the Rijksherbarium at Leiden and were illustrated by Gaertner as a species of Oleaceae under the name *Chionanthus ghaeri*. The identity between this and *Scirpodendron costatum* was established only when Boerlage published an article on this striking comparison (in J. Linn. Soc. Bot. 31: 246–248. 1895).

DISTRIBUTION: As noted above for the genus, occurring in coastal marshes and on the swampy margins of streams in forests at elevations of sea level usually to 150 m. In Fiji Guppy noted the species (on his specimen at κ) as occurring somewhat higher ("Common on both islands, in mangrove swamps and inland plateaux at alt. 800–1000 feet. Definitely indigenous. Fruits common in river drift."). However, the plant is doubtfully common in Fiji, only four specimens being available.

LOCAL NAMES AND USE: *Misimisi*; *vulu*. Guppy and also Degener and Ordenez noted that the leaves are used for thatching, but this usage must be very limited and local.

AVAILABLE COLLECTIONS: VITI LEVU: SERUA: Thulanuku, vicinity of Ngaloa, *Degener 15103*. NAITASIRI: Vicinity of Nasinu, *Gillespie 3473*. "VITI LEVU and VANUA LEVU": *Guppy*, in Dec. 1897. VANUA LEVU: THAKAUNDROVE: Maravu, near Salt Lake, *Degener & Ordenez 14249*.

The compound fruits of this species are composed of a thick utricle and an enclosed achene, of which the pericarp is completely adnate to the surrounding utricle. Whereas the size of contained achenes is fairly constant, the degree of development of the fleshy utricles is so variable that the fruits may vary from oblong-ovate through obovate to nearly obovate-orbicular in shape. The utricle, which consists of uniform parenchymatous tissue, becomes somewhat spongy in a mature dry state, making the ridges of the fruit more pronounced than in a young wet state. The ridges are either entire or markedly undulate. Such spongy utricles are assumed to adapt the achenes for floating on sea currents, whereby they can be transported from one island to another.

2. MAPANIA Aubl. Hist. Pl. Guiane Fr. 1: 47. 1775.

Thoracostachyum Kurz in J. Asiat. Soc. Bengal 38 (2): 75. 1869.

Paramapania Uittien in Rec. Trav. Bot. Néerl. 32: 184. 1935; Kern in Blumea 9: 215. 1958.

Perennial herbs; leaves radical or sometimes the upper few on culm, rarely all foliage leaves reduced to bladeless cataphylls at base of culm, the blades linear to lanceolate, 1- or 3-costate, occasionally with petiole-shaped base; culms central or lateral; inflorescence either congested in a head or a corymb with elongated rays; bracts leaflike, not sheathing; spikes compound with many imbricated glumes, each subtending an axillary spikelet; spikelets bisexual, terminated by a pistillate flower

or a single naked pistil, bearing 4–6 small scales, all or the majority bearing an axillary monandrous staminate flower, the lowest pair of scales folded with ciliate or spinulose keel; pistil with 2, 3, or rarely 4 stigmas, developing into a fruit with thick mesocarp.

TYPE AND LECTOTYPE SPECIES: Of *Mapania* the type species is *M. sylvatica* Aubl., of northeastern South America. I have not noted a lectotypification for *Thoracostachyum*, but Kurz in 1869 included two species, *T. sumatranum* (Miq.) Kurz and *T. bancanum* (Miq.) Kurz; both were originally placed in *Lepironia* by Miquel. The type species of *Paramapania* as designated by Uittien is *P. radians* (C.B. Clarke) Uittien, originally placed in *Mapania* by Clarke.

DISTRIBUTION: Tropical forests of both hemispheres, with nearly 45 species.

In Fiji the genus *Mapania* is represented by two species, *M. vitiensis* and *M. parvibractea*, which have been attributed by most regional specialists to the genera *Thoracostachyum* and *Paramapania* respectively. However, as I have noted in prior discussions, the delimitation of these genera, which depends on the number of small scales of cymules and the character of the foliage, becomes quite fictitious when the genus *Mapania* is observed on a worldwide basis.

In *Mapania sylvatica*, the type species of the genus, the cymules are composed of six small scales. The two lowest lateral scales are opposite and paired, differing from the rest in having an acute, scabrous keel, along which the scale is folded. The third scale is borne abaxially, and therefore it is often called a front scale. The remaining upper three scales are imbricated, subtending a terminal pistil. This arrangement of small scales within a cymule is most commonly seen in the species of *Mapania*. In *Thoracostachyum* the cymules exactly follow this composition of small scales and do not separate the genus from *Mapania* at all.

Modifications in the arrangement of small scales take place in the reduction and/or the connation of the scales. The complete disappearance of the front scale in cymules is seen in the majority of species that can be attributed to *Paramapania*, as well as in a number of species belonging to the sections *Pycnostachya* and *Tepuianae* of *Mapania*. Therefore, when *Paramapania* is separated from *Mapania* based on this particular character, as was originally done, it does not constitute a distinct genus. Apart from whether or not the front scale is reduced, *Paramapania* is said to possess the lowest folded small scales that are more prominently hispidulous-scabrous on the keel. I have failed to verify this point as far as I have examined the related species.

In addition to the details of cymules, mentioned above, attempts have also been made to distinguish *Thoracostachyum* and *Paramapania* by the open, corymbose inflorescence and the lateral, subscapose culms respectively. The open inflorescence, however, is not confined to *Thoracostachyum*, but is rather widely exhibited by the species of *Mapania* section *Tepuianae*, of which the closer relationship is found in *Mapania* section *Pycnocephala*, with contracted inflorescences, rather than in *Thoracostachyum*. The patterns of culms and foliage in *Mapania* are as diversified as in the related genus *Hypolytrum*. In the sections *Cephaloscirpus* and *Pycnocephala* the central culms are leaved especially toward the base, while in the section *Mapania* all the leaves of a normal kind are reduced to bladeless cataphylls surrounding the culm bases, and thus the subaphyllous culms bear well-developed bracts only at the apex. The lateral subscapose culms, which arise from the axils of central leaf tussocks, occur as one of these varying phases of mapanioid foliage



FIGURE 59. *Mapania vitiensis*, from Smith 1786; A, habit, $\times 1/2$; B, spikelet, $\times 5$; C, glume of spikelet, $\times 10$; D & E, prophylls, $\times 10$; F-I, squamellae, $\times 10$; J & K, fruits, $\times 10$. Scales = 1 mm.

types in the section *Pandanophyllum* of *Mapania* and in *Paramapania*, not permitting the generic separation of the latter based on this vegetative feature.

The above-mentioned variations in both floral and vegetative characters are also pertinent to such allied genera as *Hypolytrum* and *Mapaniopsis*, indicating that they are not special features in *Mapania*. In conclusion, I have been unable to find any valid points to support generic status for either *Thoracostachyum* or *Paramapania*.

KEY TO SPECIES

- Culms central, 90–150 cm. tall, leaved at base. 1. *M. vitiensis*
Culms lateral, 20–30 cm. tall, surrounded at base only with bladeless sheaths. 2. *M. parvibractea*

1. *Mapania vitiensis* (Uittien) T. Koyama in Allertonia 1: 341. 1978. FIGURE 59.

Thoracostachyum vitiense Uittien in Bishop Mus. Bull. 141: 16. 1936; J. W. Parham in Dept. Agr. Fiji Bull. 35: 154. 1959, Pl. Fiji Isl. 299. 1964, ed. 2. 395. 1972.

Coarse perennial, with woody, ascending rhizome; culms erect, 90–150 cm. tall, usually not nodose between inflorescence and base; leaves aggregated at base of culm, the blades elongated, broadly linear, 60–100 cm. long, 1–3 cm. broad, 3-costate, herbaceous, the sheath tinged with yellowish brown; inflorescence a large, open, hemispherical, decompound corymb, 10–15 cm. tall, 12–18 cm. across, with 5–10 elongated rays 6–9 cm. long, once or twice further branched; bracts 4–6, leaf-like, the lowest 20–45 cm. long; spikelets many, solitary or rarely paired on final branchlet, elliptic with flowers, 5–8 mm. long, 3–4 mm. broad; glumes subdensely imbricated, ovate, 2.5–3 mm. long, rounded at apex; small scales 6; stamens 3 or 6; fruits ovate-elliptic, subterete with 3 channels, 3 mm. long, 1.8–2 mm. broad, subacute at apex, rounded at base, maturing brown, shiny; stigmas 3.

TYPIFICATION: The holotype is *Smith 1786* (BISH), collected May 10, 1934, on Mt. Kasi, Yanawai River region, Thakaundrove Province, Vanua Levu.

DISTRIBUTION: Endemic to Fiji and apparently rare, known only from the type collection and one other without data. The type material was obtained in dense forest at an altitude of 300–416 m.

LOCAL NAME: *Kutukutu* (a name also applied to the single species of *Hypolytrum* in Fiji).

AVAILABLE COLLECTION: FIJI without further data, Gillespie 2460.

It is possible that this species also occurs rarely in Samoa. Dr. Smith has noted collections from Tutuila (*Christophersen 1209* (BISH) and *3484* (BISH, mixed with a staminate fragment of some other sedge, K)) which, although sterile, are similar in foliage to *Mapania vitiensis*. Kükenth had identified them as *Thoracostachyum lucbanense* (Elmer) Kükenth., which I consider a synonym of *M. parvibractea*, certainly not their correct identity.

2. *Mapania parvibractea* (C. B. Clarke) T. Koyama in Micronesica 1: 66. pl. 3, fig. C. 1964.

Hypolytrum parvibractea C. B. Clarke in Kew Bull. 1899: 114. 1899.

Hypolytrum parvibracteatum C. B. Clarke in Kew Bull. Add. Ser. 8: 51. 1908.

Paramapania parvibractea Uittien in Rec. Trav. Bot. Néerl. 33: 143. 1936; S. T. Blake in J. Arnold Arb. 28. 209. 1947; Kern in Blumea 9: 217. 1958.

Perennial with short woody rhizome; leaves many, forming a sterile tuft, the blade as much as 80 cm. long and 12 mm. broad, 1-costate, the sheath lightly reddish brown, persistent and disintegrating into fuscous fibers; culms lateral, subscapose, clothed at base with a few brownish bladeless sheaths, usually 1-vaginate at middle, 20–30 cm. tall; inflorescence a terminal corymb 2.5–5 cm. long, with

branches up to 3 cm. long; bracts spathaceous to scalelike, about 1 cm. long, brownish; spikelets many, ovoid-globose, 3–6 mm. long, 4–5 mm. broad with fruits, dark reddish brown; glumes elliptic, round-tipped, 1–1.5 mm. long; fruits ovoid to rhombic-ovoid, subterete, 1.8–2.2 mm. long, about 1 mm. broad, yellow-brown to light brown with dark red spots, the beak short; style branches 3 or 2.

TYPIFICATION AND NOMENCLATURE: The holotype is *Giulianetti s. n.* (κ), from Mt. Scratchley, New Guinea. Confusingly, *Hypolytrum parvibracteatum*, typified by the same collection, was described as a new species by Clarke in a posthumous paper which apparently was not adequately scrutinized.

DISTRIBUTION: Malay Peninsula, the Philippines, Sumatra, the Moluccas, New Guinea, Solomon Islands, and Fiji. That the species is rare in Fiji is indicated by the fact that only a single specimen of it, deposited at c, is known from the archipelago. This unexpected range extension was indicated by Kern in 1958; his identification is certainly correct, and there is no indication of a mixture of labels.

AVAILABLE COLLECTION: VITI LEVU: NAMOSI: Wainandoi River, *Nielsen 221*.

3. *HYPOLYTRUM* L. C. Rich. in Pers. Syn. Pl. 1: 70. 1805; Seem. Fl. Vit. 317. 1868.

Perennial herbs; leaves radical, sometimes the upper few on culm, the blades linear to lanceolate, 3-costate; culms central or lateral; inflorescence an umbelliform corymb, a panicle, or sometimes congested in a head, with leafy bracts; spikes compound, with many imbricated glumes, each subtending an axillary spikelet; spikelets bisexual, consisting of 2 small scales (prophylls), the prophylls lateral and opposite, folded with usually hispid keel, both bearing a monandrous staminate flower at axil; pistillate flower a terminal naked pistil with 2 stigmas, later developing into a biconvex fruit with thick mesocarp.

LECTOTYPE SPECIES: Richard included three species in his new genus in 1805. As a lectotype, my indication of *Hypolytrum latifolium* L. C. Rich. (in J. Fac. Sci. Univ. Tokyo, Sect. 3, Bot. 8: 68. 1961, and also in Mem. New York Bot. Gard. 17: 69. 1967) may be accepted; this is now considered a synonym of *H. nemorum* (Vahl) Spreng.

DISTRIBUTION: About 50 species are recognized in the tropical regions of both hemispheres; the center of maximum variation is in the neotropics. There is a single taxon in Fiji which, as indicated below, I consider a subspecies of *Hypolytrum nemorum*.

1. *Hypolytrum nemorum* subsp. *vitiense* (C. B. Clarke) T. Koyama in Micronesica 1: 68. 1964; J. W. Parham, Pl. Fiji Isl. ed. 2. 394. 1972.

Hypolytrum giganteum sensu Seem. in Bonplandia 9: 261. 1861, Viti, 444. 1862; non Roxb.

Hypolytrum latifolium sensu Seem. Fl. Vit. 317. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 333. 1892; J. W. Parham in Dept. Agr. Fiji Bull. 35: 150. 1959; non L. C. Rich.

Hypolytrum vitiense C. B. Clarke in Kew Bull. Add. Ser. 8: 51. 1908; J. W. Parham in Dept. Agr. Fiji Bull. 35: 150. 1959.

Hypolytrum nemorum sensu J. W. Parham, Pl. Fiji Isl. 299. 1964; non Spreng.

More or less tufted perennial with short woody rhizome; culms 60–130 cm. tall, 1- or 2-nodose; leaves basal and with 1 or 2 upper ones on the culm, the blades broadly linear, 1–2.8 cm. broad, the longer overtopping the culm, 3-costate, herbaceous, the sheaths (especially the radical ones) cinnamon-colored; inflorescence a hemispherical simple or compound corymb, 4–6 cm. long, 7–11 cm. across, open with elongated rays up to 8 cm. long; involucre bracts 2 or 3, leafy, the first one 20 cm. long or more, not sheathing at base; spikes oval to broadly elliptic at maturity, 5–9 mm. long, 5–7 mm. across, rusty-brown; glumes oval, 2 mm. long, membranous,

contracted at mucronate apex; fruits elliptic to ovate, biconvex, 2.5–3.25 mm. long, 1.7–1.9 mm. broad, yellow-brown with reddish lineolae, weakly rugose; stigmas 2.

LECTOTYPIFICATION AND NOMENCLATURE: The only basionym concerned is *Hypolytrum vitiense*; below I discuss reasons for using this at the subspecific level. In the original publication of his binomial, Clarke did not indicate a type, citing: "Polynesia. Fiji Islands, *Milne*, nn. 26, 23, 180; *Seemann*, n. 666; *Graeffe*, n. 1238; *Horne*, n. 356; *MacGillivray*; *Weber*, n. 129." As to choice of a lectotype, *Seemann* 666 bears excellent drawings, but Clarke has written "type of species" on *Horne* 356; therefore I herewith propose to take this latter specimen (at κ) as the lectotype. It was collected in Fiji without further data.

DISTRIBUTION: *Hypolytrum nemorum* as a species has a wide range, from India and Taiwan through Malesia eastward to Queensland and Polynesia. Subspecies *vitiense*, however, is confined to Fiji and the West Carolines. In Fiji this subspecies occurs abundantly (about 65 collections being available) at elevations of sea level to 800 m., in dense, thin, or dry forest or forest patches, but also often in wet places and swamps; it is seen in flower and fruit at any season.

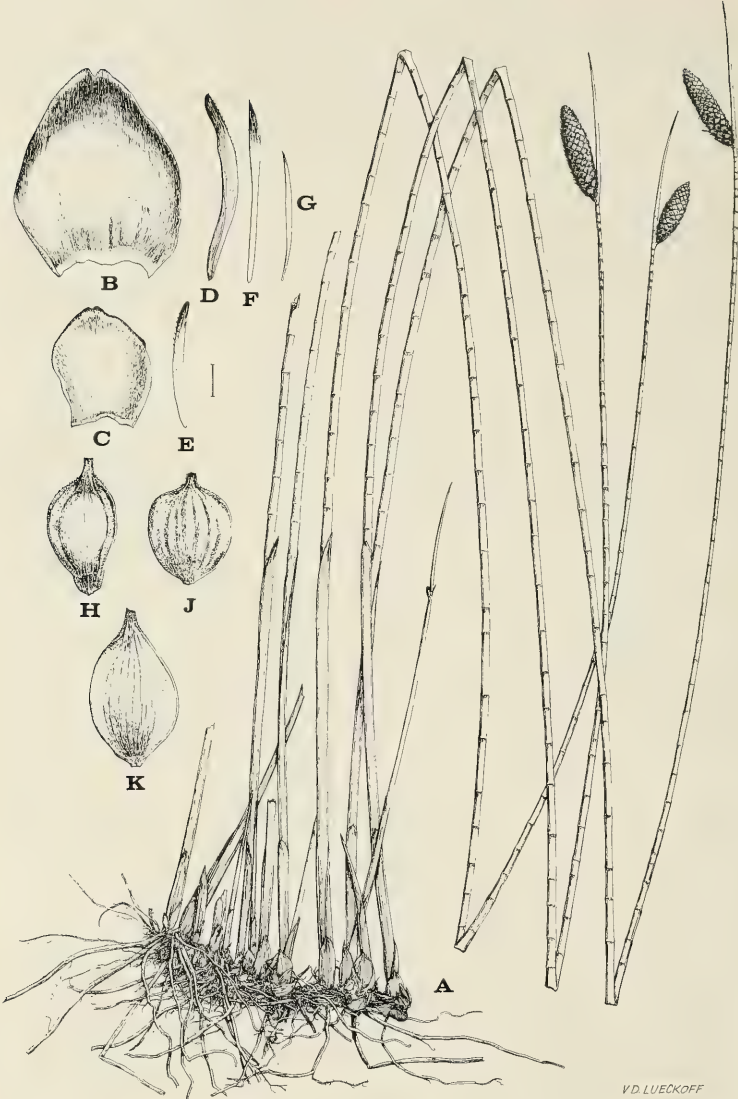
LOCAL NAMES: *Kutu*; *kutukutu*; *misimisi*.

REPRESENTATIVE COLLECTIONS: VITI LEVU: NANDRONGA & NAVOSA: Nausori Highlands, *O. & I. Degener* 32346. SERUA: North of Korovou, *St. John* 18937; hills east of Navua River, near Nukusere, *Smith* 9108. NAMOSE: Hills north of Wainavindrau Creek, *Smith* 8413; hills near Navua River, *Greenwood* 1050. NAITASIRI: Waimanu River, *DA* 15590; Tholo-i-suva, *Setchell & Parks* 15148; Suva Pumping Station, *Degener & Ordenez* 13743a. TAILEVU: Hills east of Wainimbuka River, near Ndaquivuna, *Smith* 7044; west of Korovou, *O. & I. Degener* 32257. REWA: Slopes of Mt. Korombamba, *Gillespie* 2263; vicinity of Suva, *Meebold* 21937. VITI LEVU without further locality, *Milne* 26, 180, *Graeffe* 1232. KANDAVU: Hills above Namalata and Ngaloa Bays, *Smith* 136. "KANDAVU, OVALAU and TAVEUNI": *Seemann* 666. OVALAU: Hills east of Lovoni Valley, *Smith* 7258; Ovalau without further locality, *MacGillivray*. KORO: Eastern slope of main ridge, *Smith* 1016. NGAU: Without further locality, *MacGillivray*. VANUA LEVU: MATHUATA: Seanggangga Plateau, *DA* 10491; Mt. Numbuiloa, east of Lambasa, *Smith* 6452. THAKAUNDROVE: Mt. Kasi, *DA* 15729; southwestern slope of Mt. Mbatini, *Smith* 608. FIJI without further locality, *U.S. Expl. Exped.*

The taxon in Fiji and the West Carolines is often considered identical with the typical form of *Hypolytrum nemorum* (Vahl) Spreng. Syst. Veg. 1: 233. 1824 (based on *Schoenus nemorum* Vahl, Symb. Bot. 3: 8. 1794, and not separable from *Hypolytrum latifolium* L.C. Rich. in Pers. Syn. Pl. 1: 70. 1805). However, there are differences between the two taxa in the characters of the fruits, as I remarked in proposing the new subspecies in 1964. The fruits of subsp. *vitiense* are less distinctly rugose than those of subsp. *nemorum* and they are definitely larger, 2.75–3.25 \times 1.75–1.9 mm. as against 2–2.5 \times 1.3–1.7 mm. In subsp. *vitiense* the relatively less congested spikes tend to be ellipsoid, in contrast to the very densely flowered, truly globose spikes of subsp. *nemorum*. In the two disjunct areas where it occurs, subsp. *vitiense* seems completely to replace subsp. *nemorum*.

4. LEPIRONIA L.C. Rich. in Pers. Syn. Pl. 1: 70. 1805; Seem. Fl. Vit. 315. 1868.

Subaphyllous perennial herbs; culms terete, transversely septate, clothed at base with bladeless sheaths only, the sheaths open on one side; inflorescence pseudolateral with 1–several sessile spikelets; involucre bract 1, erect, culmlike, the base dilated with cartilaginous margins; spikelets with many spirally imbricated coriaceous glumes, each subtending a cymule; cymules terminated by a single naked pistillate flower, bearing many small scales (squamellae), the 3 or 4 squamellae immediately below the pistil empty, the remainder generally bearing an axillary monandrous staminate flower, the lowest pair folded with an acute keel; pistil maturing into obovate, more or less flat, veined fruit.



TYPE SPECIES: The only original species was *Lepironia mucronata* L.C. Rich., a synonym of *L. articulata* (Retz.) Domin.

DISTRIBUTION: About five species in the Old World tropics, from Madagascar through the Indian subcontinent and Malesia eastward to the Caroline Islands, Australia, and New Caledonia to Fiji and Tonga. Only one species extends into the eastern portion of the generic range.

1. *Lepironia articulata* (Retz.) Domin in Biblioth. Bot. **20** (Heft 85): 486. 1915; S. T. Blake in Proc. Roy. Soc. Queensland **54**: 71. 1943; T. Koyama in Micronesica **1**: 69. 1964; J. W. Parham, Pl. Fiji Isl. 299. 1964, ed. 2. 394. 1972. FIGURE 60.

Restio articulatus Retz. Obs. Bot. **4**: 14. 1787.

Lepironia mucronata L.C. Rich. in Pers. Syn. Pl. **1**: 70. 1805; Seem. in Bonplandia **9**: 261. 1861, Viti, 444. 1862, Fl. Vit. 315. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 333. 1892; Yuncker in Bishop Mus. Bull. **220**: 73. 1959; J. W. Parham in Dept. Agr. Fiji Bull. **35**: 154. 1959.

Subaphyllous perennial with decumbent woody rhizome; culms erect, arranged in a row along rhizome, slenderly cylindric, 50–250 cm. tall, 2–8 mm. thick, hollow and transversely septate, glaucous-green, clothed at base with about 3 sheaths and 4 or 5 scales; sheaths 3–30 cm. long, split on one side, obliquely truncate at orifice; inflorescence a single pseudolateral spikelet, ovate to oblong, 10–35 mm. long, 3–7 mm. thick, brown to purple-brown; rachis thick, bearing tightly imbricated glumes; involucrel bract 1, erect, culmlike, 2–6 cm. long, not septate; glumes oval to obovate-orbicular, coriaceous with cartilaginous margin, those from middle part of spike 3–7 mm. long; squamellae 10–14, linear-lanceolate; fruits oval to obovate, dorsiventrally flattened, 3–4 mm. long, 2–2.8 mm. broad, contracted at both ends, brown, 7- to 9-nerved, the beak 0.5 mm. long; stigmas 2.

TIPIFICATION AND NOMENCLATURE: The holotype of *Restio articulatus* is König (c), from Tranquebar, southern India. *Lepironia mucronata* is typified by material from Madagascar. Recent authors find no significant differences between the two concepts.

DISTRIBUTION: *Lepironia articulata* has the distribution of the genus; it is also cultivated in southeastern China. In Fiji it is very limited in extent, being known with certainty only from Taveuni and possibly only from the vicinity of the old "lake" east of Somosomo, where it is locally abundant in swamps and morasses at elevations of 600–900 m.

LOCAL NAMES AND USES: *Mototuila*; *kuta*. It is said to be used in Fiji for making mats, but perhaps these have been seen only on Taveuni. In China bags made of such matting, called "ampera," are used for the transportation of cane sugar.

AVAILABLE COLLECTIONS: TAVEUNI: Borders of lake east of Somosomo, Smith 852, DA 12402; "Vuna," Seemann 667. FIJI without further locality, DA 3431.

It is probable that Seemann's collection also came from the old "lake," which he visited on May 30, 1860 (cf. Viti, 26–30. 1862). Seemann describes the lake as a large extinct crater filled with water and partially covered with a jellylike mass several feet thick, composed of microscopic cryptogams and given a degree of consistency only by a "tall species of sedge." It has been visited more recently by other botanists, who like Seemann have found the swamp to be a fascinating and perhaps

unique area in Fiji. "Vuna," which actually refers only to the southern part of the island, was often misused by Seemann in his field notes to mean Taveuni in general.

5. *SCLERIA* Bergius in Kongl. Vetensk. Acad. Handl. 26: 142. 1765; Seem. Fl. Vit. 316. 1868; Kern in Blumea 11: 150. 1961.

Large or small perennials, often with woody rhizomes, or small annuals; culms erect or climbing, many-noded, leafy; radical leaves in most species reduced to bladeless sheaths; cauline leaves with elongate blade, occasionally forming pseudo-whirls due to abbreviation of several internodes, the blades linear, 3- or 5-costate, the apex of ventral part of sheaths forming a tongue-like appendage (contra-ligule) beyond the orifice; inflorescence consisting of a terminal and 1-several lateral panicles, or rarely the whole inflorescence reduced to a glomerate or spiciform cluster of spikelets; spikelets unisexual or occasionally bisexual, or bisexual and staminate, the pistillate ones with 1 terminal pistillate flower and few to several empty glumes, the staminate ones with few to many spicately disposed flowers, each subtended by a glume, and the bisexual ones with 1 terminal pistillate flower and few to several glumes, of which 1-few bear an axillary staminate secondary spikelet; staminate flowers with 1-3 stamens; pistillate flowers a single 3-carpellate pistil, developing into a bony achene over a disc of varying shape.

LECTOTYPE SPECIES: Bergius had two species, of which Core (in Brittonia 2: 88. 1936) chose *Scleria flagellum-nigrorum* Bergius as the lectotype species.

DISTRIBUTION: More than 220 species, principally in the tropics and subtropics of both hemispheres, but with some species extending into warm temperate regions as well. Two species are found in Fiji.

USEFUL TREATMENT OF GENUS: Kern, J. H. *Scleria*. Fl. Males. I. 7: 722-751. 1974.

KEY TO SPECIES

- Disc of achene 1/2-1/3 the length of achene body, deeply 3-lobed; spikelets unisexual, subdensely borne on a well-branched panicle; leaves 5-9 mm. broad, those on middle part of culms forming pseudo-whirls of 2-5; large herb 80-120 cm. tall. 1. *S. polycarpa*
- Disc of achene a small obsolete annule at base of achene body; spikelets bisexual, loosely spicately disposed on a few distant branches of inflorescence; leaves 1.5-4 mm. broad, all spaced; medium-sized herb less than 80 cm. tall. 2. *S. lithosperma*

1. *Scleria polycarpa* Boeck. in Linnaea 38: 509. 1874; S. T. Blake in J. Arnold Arb. 35: 230. 1954; Kern in Blumea 11: 183. fig. 6, a. 1961; T. Koyama in Micronesica 1: 72. 1964; J. W. Parham, Pl. Fiji Isl. ed. 2. 395. 1972; Kern in Fl. Males. I. 7: 738. fig. 105 (15). 1974. FIGURE 61.

Scleria margaritifera sensu Willd. Sp. Pl. 4: 312. 1805; Seem. Fl. Vit. 316. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 336. 1892; Yuncker in Bishop Mus. Bull. 220: 74. 1959; J. W. Parham in Dept. Agr. Fiji Bull. 35: 154. 1959, Pl. Fiji Isl. 299. 1964; non Gaertn. (1788).

Scleria sp. Seem. in Bonplandia 9: 261. 1861, Viti, 444. 1862.

Scleria micrantha C. B. Clarke in Kew Bull. Add. Ser. 8: 58. 1908.

Scleria scrobiculata sensu Christophersen in Bishop Mus. Bull. 128: 23. 1935; Yuncker in op. cit. 184: 27. 1945; J. W. Parham in Dept. Agr. Fiji Bull. 35: 154. 1959, Pl. Fiji Isl. 299. 1964; non Nees & Meyen ex Nees.

Perennial with short-creeping woody rhizome; culms erect, 80-120 cm. tall, 3-6 mm. thick, sharply triquetrous with scabrous angles, leafy; leaves cauline, those on midway portion of culm clustered, forming pseudowhirls of 2-5, the blades linear, coriaceous, 20-50 cm. long, 5-9 mm. broad, the sheath not winged; inflorescence with a terminal panicle and up to 7 lateral panicles, 20-50 cm. long, the panicles oblong in outline, 7-10 cm. long, single or binate at node, with erect-patent nearly spiciform short branches; bracts leaflike; spikelets in clusters of 2 or 3, unisexual, the staminate ones 3 mm. long, the pistillate ones about 4 mm. long, evenly distributed throughout inflorescence; pistillate glumes broadly ovate, 2.8-3.5 mm. long;



FIGURE 61. *Scleria polycarpa*, from Degener & Ordóñez 13655; A, habit, $\times 1/2$; B, pistillate cymule and staminate spikelet, $\times 7.5$; C-E, pistillate glumes, $\times 7.5$; F, fruit with its hypogynium, $\times 7.5$. Scales = 1 mm.

achenes globose, 2–2.5 mm. long and broad, white or tinged with blue, nearly smooth, sparingly puberulent, the disc coriaceous, deeply 3-lobed, the lobes 1/3–1/2 the length of achene.

LECTOTYPIFICATION AND NOMENCLATURE: For *Scleria polycarpa*, Boeckeler's whole citation was: "Ex herb. Hooker Insulae Fichi." At κ , however, no annotation of this species is in Boeckeler's handwriting (Miss S.S. Hooper, pers. comm.). The only specimen of *S. polycarpa* annotated in a hand other than C.B. Clarke's is *Milne 418*, which Miss Hooper thinks may have been annotated by Hooker. This specimen, therefore, is herewith indicated as the lectotype. *Milne 418* was collected in November, 1854, on Viti Levu without further locality. As to *S. margaritifera* Willd., this would appear to be strictly a misidentification, Willdenow having thought that he had the same species as Gaertner; therefore it can really have no type. Nevertheless, some authors have interpreted *S. margaritifera* Willd. as a new species and a later homonym of Gaertner's species (e.g. Kern in 1961), indicating as its type a specimen collected on Tanna, New Hebrides, by J.R. and G. Forster during Cook's second voyage; there is such a specimen in the type cover at κ so annotated by Clarke. *Scleria micrantha* has as its holotype *Milne 18* (κ), collected in 1858 on Viti Levu without further locality; it is in every respect identical with other Fijian material of *S. polycarpa*. As to *S. scrobiculata*, this has been considered by several authors (e.g. Kern in 1961 and myself in 1964) to extend eastward as far as Fiji, Samoa, and Tonga; now, however, I believe that such specimens are better referred to *S. polycarpa*.

DISTRIBUTION: *Scleria polycarpa* has a range extending from Samoa and Tonga westward through Melanesia, the Marianas and Carolines, and West Malesia to northeastern Australia. In Fiji it is frequent (about 60 collections being at hand) at altitudes from near sea level to 900 m., occurring in various types of forest and cleared hillsides and often forming tangles in moist places. It is seen in flower and fruit throughout the year.

LOCAL NAMES: *Vesivesi*; *nitinititi*; *tavatava-i-randuna*.

REPRESENTATIVE COLLECTIONS: YASAWAS: WAYA: Olo Creek, north of Yalombi, *St. John 18016*. VITI LEVU: MBA: Lautoka, *DA 8218*; Nandarivatu, *Gillespie 4175*. NANDRONGA & NAVOSA: Nausori Highlands, *O. & I. Degener s. n.* SERUA: Ngaloa, *Degener & Ordonez 13614*. RA: Near Nasukamai, Lawaki River headwaters, *Gillespie 3394.3*; Ndombuilevu, *DA 7851*. NAITASIRE: Tholo-i-suva, *DA 11252*; Suva Pumping Station, *Degener & Ordonez 13655*. TAILEVU: Hills east of Wainimbuka River, near Ndakui-vuna, *Smith 7155*. REWA: Naikorokoro Creek, *Meebold 21925*; Mt. Korombamba, *DA 1182*. YANUTHA: *DA 9037*. KANDAVU: Hills above Namalata and Ngaloa Bays, *Smith 95*. OVALAU: *MacGillivray*, Oct. 1854; near Levuka, *Degener & Ordonez 13783*. WAKAYA: *Milne 399*. NGAU: *Milne 217*; hills east of Herald Bay, *Smith 7995*. VANUA LEVU: MBUA: Rukuruku Bay area, *H. B. R. Parham 376*. MATHUATA: Southern slopes of Mt. Numbuiloa, east of Lambasa, *Smith 6390*. THAKAUNDROVE: Mt. Kasi, *DA 15728*; vicinity of Savusavu, *Harwood 68*. TAVEUNI: Somosomo, *Seemann 677*. MOALA: *Milne 133*. MATUKU: *Milne 119*. VANUA MBALAVU: Near Lomaloma, *Garnock-Jones 1008*. LAKEMBA: Tumbou River, *Garnock-Jones 848*.

2. *Scleria lithosperma* (L.) Sw. Nov. Gen. & Sp. Prodr. 18. 1788; Seem. Fl. Vit. 316. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 336. 1892; Christophersen in Bishop Mus. Bull. 128: 23. 1935; Yunker in op. cit. 184: 27. 1945, in op. cit. 220: 73. 1959; J. W. Parham in Dept. Agr. Fiji Bull. 35: 154. 1959; Kern in Blumea 11: 191. fig. 6, h. 1961; T. Koyama in Micronesica 1: 71. 1964; J. W. Parham, Pl. Fiji Isl. 299. 1964, ed. 2. 395. 1972; Kern in Fl. Males. I. 7: 740. fig. 105 (19). 1974.

Scirpus lithospermus L. Sp. Pl. 51. 1753.

Scleria sp. Seem. in Bonplandia 9: 261. 1861, Viti, 444. 1862.

Slender perennial, loosely tufted with short knotty rhizome; culms 40–80 cm. tall, triquetrous, smooth; leaves equally distributed or somewhat dense at middle part of culm, the blades narrowly linear, 8–40 cm. long, 1.5–4 mm. broad, stiff, the sheath 6–9 cm. long, brownish red, pubescent; inflorescence consisting of 3 or 4 distantly borne, loose, narrow panicles, these 20–35 cm. long, 2–3 cm. broad, sometimes becoming nearly spiciform, the lateral panicles single; bracts leaflike, much surpassing the inflorescence; spikelets bisexual, solitary or 2 or 3 together, 3–5 mm. long; glumes subtending achene ovate, 3–4 mm. long, rusty-brown; glume immediately below fruit bearing an axillary staminate secondary spikelet; achenes obovoid or obovoid-ellipsoid, 2–2.75 mm. long, 1.75–2 mm. across, rounded at apex, white, smooth, shiny, with three depressions at cuneate base, the disc obsolete, reduced to a small annulus at base of achene.

TYPE: Linnaeus originally indicated: "*Habitat in India*," but in his second edition this was altered to "*India occidentalis*," which is more probably correct.

DISTRIBUTION: Pantropic, and apparently the commonest and most widespread species of *Scleria*. Kern (in 1961) proposed a var. *lithosperma*, to which the Pacific material belongs, to contrast with var. *linearis* Benth. (Fl. Austral. 7: 430. 1878), which occurs from Ceylon and India to tropical Australia and Malesia; according to Kern, Boeckeler has recorded this second variety also from Fiji, but in my observation all the Fijian material falls into the typical variety. In Fiji the species is often locally abundant, about 35 collections being available; it occurs at elevations from near sea level to 450 m., in dense or dry forest, thickets, on hillsides, and often on swampy ground. It is in flower and fruit throughout the year.

LOCAL NAME: *Weisa* (recorded only from the Yasawas).

REPRESENTATIVE COLLECTIONS: YASAWAS: WAYA: Olo Creek, north of Yalombi, *St. John* 18015. MAMANUTHAS: Malolo Group: NGGALITO, O. & I. *Degener* 32252. VITI LEVU: Mba: Lautoka, *DA* 9639; Korovou, east of Tavua, *Degener* 14944. NANDRONGA & NAVOSA: Southern slope of Nausori Highlands, in drainage of Namosi Creek, *Smith* 4599. SERUA: Coastal hills east of Wainiyambia, *Smith* 9600. RA: Vaileka, *DA* 8096. YANUTHA: *DA* 9038. OVALAU: *Milne* 282; near Levuka, *Degener & Ordonez* 13784. WAKAYA: *MacGillivray* s. n. NGAU: Shore of Herald Bay in vicinity of Sawaieke, *Smith* 7924. VANUA LEVU: MATHUATA: Lambasa, *Greenwood* 529; Undu Point, *Tothill* 858. THAKAUNDROVE: Vicinity of Savusavu, *Bierhorst* F40. TAVEUNI: *Seemann* 676. MOALA: *Milne*, Sept. 1854; near Maloku, *Smith* 1381. IOIOYA: *Milne* 82, *DA* 13244. MATUKU: South side of Ngilinglia Mt., *Bryan* 274. VANUA MBALAVU: Central volcanic section near Lomaloma, *Smith* 1418.

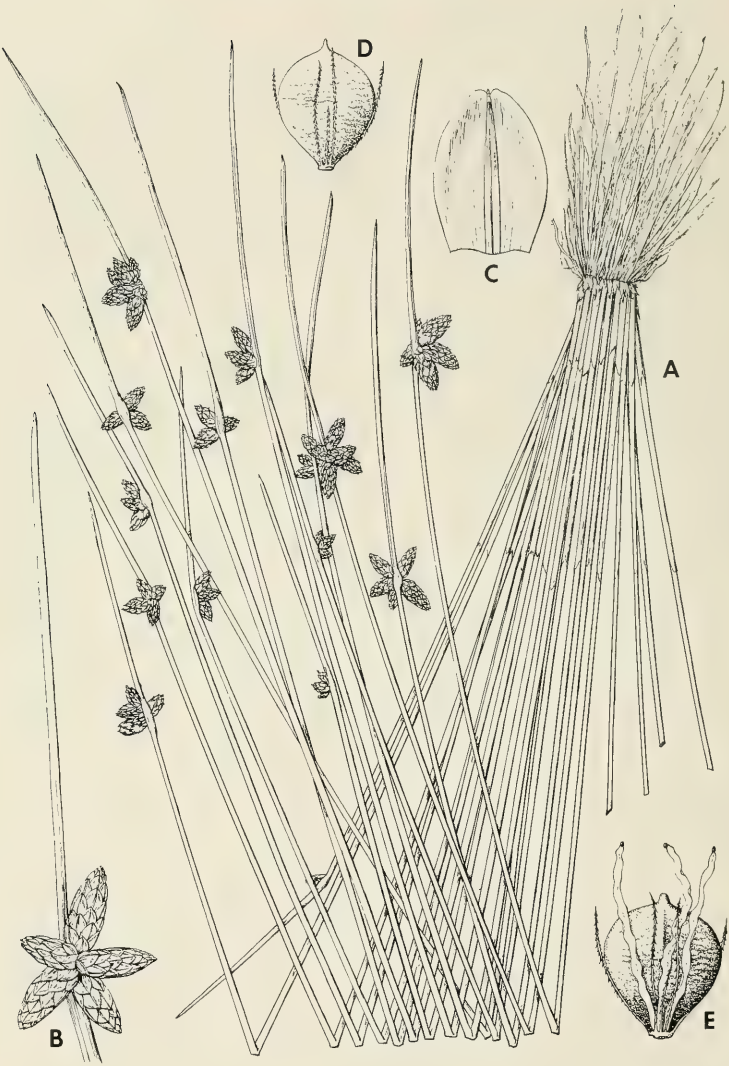
6. *SCHOENOPECTUS* Palla in Sitzungsber. Zool.-Bot. Ges. Wien 38: 49. 1888, in Bot. Jahrb. 10: 298. 1888. Nom. cons.

Scirpus sect. *Schoenoplectus* Reichenb. Icon. Fl. Germ. 8: 40. 1846.

Annuals or perennials, occasionally with rhizomes; stems leafless, surrounded at base with bladeless sheaths only; leaves reduced to bladeless sheaths, rarely with a short blade; inflorescence subtended by an erect, culmlike bract, hence becoming quasi-lateral, corymbose with elongated rays or congested in a head; spikelets ovoid to ellipsoid, terete, many-flowered; glumes as a rule imbricated, rarely 2-ranked, all alike and bearing an axillary bisexual flower; flowers hermaphrodite with a pistil and (1–) 3 stamens, these subtended by 0–6 hypogynous bristles; achene dorsiventrally lenticular or 3-sided; style elongated, not thickened at base; stigmas 2 or 3.

TYPE SPECIES: *Schoenoplectus lacustris* (L.) Palla (*Scirpus lacustris* L.).

DISTRIBUTION: A genus of more than 40 species, occurring in tropical, subtropical, and temperate regions of both hemispheres. Only one species is known from Fiji.



1. *Schoenoplectus juncoides* (Roxb.) Palla in Bot. Jahrb. 10: 299. 1888. FIGURE 62.

Scirpus juncoides Roxb. Hort. Beng. 81, nom. nud. 1814, Fl. Ind. 1: 218. 1820; T. Koyama in J. Fac. Sci. Univ. Tokyo, Sect. 3, Bot. 7: 310, fig. 9. 1958; J. W. Parham, Pl. Fiji Isl. ed. 2. 394. 1972.

Scirpus purshianus sensu Greenwood in J. Arnold Arb. 25: 397. 1944, in op. cit. 30: 82. 1949; J. W. Parham in Dept. Agr. Fiji Bull. 35: 149. 1959, Pl. Fiji Isl. 299. 1964; non Fernald.

Scirpus mucronatus sensu J. W. Parham in Dept. Agr. Fiji Bull. 35: 149. 1959, Pl. Fiji Isl. 299. 1964; non L.

Tufted in clumps, without a conspicuous rhizome; culms 15–70 cm. tall, 1–4 mm. thick, subterete or obtusely several-angled, light green, dull, clothed at base with few sheaths only; sheaths 3 or 4, the lower ones scalelike, brownish, the upper ones 5–15 cm. long, pale green, obliquely truncate at mucronate orifice; inflorescence a pseudolateral head with (1–) 2–9 (–12) spikelets; bract 5–15 cm. long, rather suddenly subacute at apex, 1-furrowed on ventral side, dilated at base; spikelets oblong to ovoid-oblong, 6–18 mm. long, 3–6 mm. broad, straw-colored, rather suddenly contracted to subobtuse apex, densely many-flowered; glumes oval to ovate-oval, 3–4 mm. long, 1.8–2.7 mm. broad, thickly membranous, pale and brown-tinged, the apex rounded to shallowly emarginate and mucronate, the keel broad, green, 1- or 3-nerved; achenes broadly obovate, unequally biconvex, 1.8–2 mm. long, about 1.5 mm. broad, suddenly contracted to cuneate base, rounded to mucronate apex, the sides maturing dark brown, shiny, transversely wrinkled; style 2–2.2 mm. long, somewhat flattened; stigmas 2, but occasionally with a rudimentary third one; hypogynous bristles 4–6, retrorsely scabrous except for base, 4 as long as or slightly surpassing the achene, the others half as long as the achene or shorter.

TYPEIFICATION AND NOMENCLATURE: Roxburgh's type was a native of wet and marshy places in India. The name most frequently used in Fiji, *Scirpus purshianus* Fernald, designates a plant confined to North America. *Scirpus mucronatus* L. (cf. Kern in Reinwardtia 6: 33. 1961) is distributed from southern Europe through southern Asia to Japan and Australia.

DISTRIBUTION: From India through southeastern Asia and Japan into Malesia and northern Australia, occurring as an adventive in other parts of the Pacific. In Fiji it occurs in swamps and open places, along roadsides, and especially in rice fields, at elevations of sea level to 150 m. It has become firmly established in the Navua delta area of southern Viti Levu; about 20 specimens have been obtained, but these do not give a true picture of its abundance. Flowers and fruits appear at any time of year, but no local name seems to have been used in Fiji.

REPRESENTATIVE COLLECTIONS: VITI LEVU: SERUA: Navua River, Greenwood 980; Nakaulevu, Navua, DA 11440; Tokotoko road (and into adjacent Namosi Province), DA 2851, 9443. NAMOSI: Valley of Wainavindrau Creek, in vicinity of Wainimakutu, Smith 8850. TAILEVU: Nausori, DA 11827; Wainimbokasi, DA 10574. REWA: Veisari, DA 11000; Lokia, DA 8591. VANUA LEVU: MATHUATA: Near Ndaku, DA 8785; Vuniviti, Lambasa, DA 10459.

The date of arrival of this weed in Fiji is not known, but apparently Greenwood's collection from the Navua River, made in May, 1943, is the first to have been recorded.

7. *Eleocharis* R. Br. Prodr. Fl. Nov. Holl. 224. 1810; Seem. Fl. Vit. 318, as *Elaeocharis*. 1868.

Annual or perennial herbs, often with short rhizomes and/or slender elongated stolons; culms slender to thickish, terete or angular, occasionally empty or trans-

FIGURE 62. *Schoenoplectus juncoides*, from Koyama 14591 from Japan; A, habit, $\times 2/3$; B, inflorescence with involucre bracts, $\times 1.3$; C, floral glume, $\times 7$; D & E, ventral and dorsal views of achene with hypogynous bristles, $\times 7$.

versely septate, leafless and clothed at base with a few cylindric bladeless sheaths, these usually membranous; inflorescence a terminal single spike bearing a scalelike bract at base; spikes ovoid, ellipsoid, or cylindric, few-many-flowered, the rachis continuous; floral glumes all alike, spirally imbricated or rarely 2-ranked, membranous to subcoriaceous, bearing a hermaphrodite flower at axil; flowers surrounded by 4-8 hypogynous bristles, consisting of 1-3 stamens and a pistil; pistils clearly bordered between style base and ovary, the style falling apart from the style base, which persistently crowns the achene; style base conical, more or less spongy; stigmas 2 or 3; achenes mostly obovate, trigonous or lenticular, the surfaces smooth or cancellate with hexagonal or transversely oblong epidermal cells.

LECTOTYPE SPECIES: Brown originally included eight species in his genus. There is no ING card indicating a lectotypification, but the lectotype species is commonly taken to be *Eleocharis capitata* R. Br. (= *E. geniculata* (L.) Roemer & Schultes).

DISTRIBUTION: About 120 species rather evenly scattered in all climatic regions, showing a high degree of morphological differentiation in the tropics.

KEY TO SPECIES

Spikes cylindric, nearly as broad as culm apex; culms 3-8 mm. thick.

Culms not septate, solid. 1. *E. ochrostachys*

Culms manifestly transversely septate, the intersepta empty. 2. *E. dulcis*

Spikes ovoid-globose, much broader than culm apex; culms up to 1 mm. broad. 3. *E. geniculata*

1. *Eleocharis ochrostachys* Steudel in Zoll. Syst. Verz. 1: 62, nom. nud. 1854, Syn.

Pl. Glum. 2: 80. 1854; T. Koyama in Micronesica 1: 77. 1964; J. W. Parham, Pl.

Fiji Isl. 298. 1964, ed. 2. 393. 1972; Kern in Fl. Males. 1. 7: 528. fig. 35. 1974.

Scirpus laxiflorus Thw. Enum. Pl. Zeyl. 435. 1864.

Eleocharis variegata var. *laxiflora* C. B. Clarke in Hook. f. Fl. Brit. Ind. 6: 626. 1893.

Eleocharis laxiflora Pfeiffer in Mitt. Inst. Allg. Bot. Hamburg 7: 169, as *Heleocharis* 1. 1928; J. W.

Parham in Dept. Agr. Fiji Bull. 35: 150. 1959.

Loosely tufted perennial with long creeping stolons; culms terete to obscurely angular, 30-60 cm. tall, 2-5 mm. thick, not transversely septate, rather rigid, clothed at base with membranous purplish sheaths obliquely truncate at orifice; spike cylindric, 1-2 cm. long, 3-4 mm. thick, as broad as or slightly broader than distal part of culm, acute at apex, weakly angular, pale green, several-flowered; glumes ovate-oblong, obtuse, 4-5 mm. long, 2-3.2 mm. broad, chartaceous with broad scarious margins, several-nerved in median area; achenes broadly obovate, 1.5-2 mm. long, about 1 mm. broad, maturing shining straw-color or gray, cancellate by some 20 rows of transversely oblong cells, the apex annulate, 1/2 to 3/4 as broad as achene body; style base deltoid; hypogynous bristles 5-7, 2-3 times as long as achene, retrorsely scabrous on upper half; stamens 2 or 3.

TIPIFICATION AND NOMENCLATURE: *Eleocharis ochrostachys* is typified by *Zollinger 291* (p?), collected in Java. The type of *Scirpus laxiflorus*, which is not to be distinguished from the preceding, is "C.P. 3762," from the southern part of Ceylon.

DISTRIBUTION: India and Ceylon to Taiwan and the Ryukyus, eastward through Malasia and Micronesia into Melanesia. In Fiji it occurs from near sea level to 400 m. in swamps and wet places, often in forests. Although flowers and fruits have been obtained only in June, July, and December, this is probably merely an accident of collecting a fairly infrequent species, known from only nine Fijian collections.

LOCAL NAME AND USE: *Sasa*. Said to be used for making mats.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Forest Nursery, Lautoka, DA 8219. SERUA: Ndeumba, west of Navua, DA 9179 (McKee 2743). RA: Vicinity of Nasukamai, near Lawaki River, Wainimbuka River basin, Gillespie 4692.1. NAITASIRI: Near Nawangambena, DA 1215. REWA: Lomanikoro, DA

778. VANUA LEVU: MBUA without further locality, DA 2286. THAKAUNDROVE: Mt. Kasi, DA 15724. FIJI without further locality, U.S. Expl. Exped., Horne s. n.

2. *Eleocharis dulcis* (Burm. f.) Trin. ex Henschel, Vita Rumph. II, 186. 1833; Merr. Interpret. Rumph. Herb. Amb. 104. 1917; Christophersen in Bishop Mus. Bull. 128: 18. 1935; S. T. Blake in Proc. Roy. Soc. Queensland 50: 103. 1939; Yunker in Bishop Mus. Bull. 184: 26. 1945, in op. cit. 220: 71. 1959; J. W. Parham in Dept. Agr. Fiji Bull. 35: 150. 1959; T. Koyama in Micronesica 1: 77. 1964; J. W. Parham, Pl. Fiji Isl. 298. 1964, ed. 2. 392. 1972; Kern in Fl. Males. I. 7: 529. fig. 36. 1974. FIGURES 8 (lower), 12 (lower).

Andropogon dulce Burm. f. Fl. Ind. 219. 1768.

Scirpus plantaginoides Rottb. Descr. Icon. Rar. Pl. 45. t. 15. fig. 2. 1773.

Scirpus plantagineus Retz. Obs. Bot. 5: 14. 1788.

Eleocharis plantaginea Roemer & Schultes, Syst. Veg. 2: 150. 1817; J. W. Parham, Pl. Fiji Isl. 298. 1964, ed. 2. 393. 1972.

Eleocharis articulata sensu Seem. in Bonplandia 9: 261. 1861, Viti, 444. 1862, Fl. Vit. 318. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 331, as *Heleocharis a.* 1892; J. W. Parham in Dept. Agr. Fiji Bull. 35: 150. 1959; non Steudel.

Eleocharis cylindrostachys sensu Greenwood in Proc. Linn. Soc. 154: 105. 1943; J. W. Parham in Dept. Agr. Fiji Bull. 35: 150. 1959, Pl. Fiji Isl. 298. 1964, ed. 2. 392. 1972; non Boeck.

Tufted perennial with short rhizome and elongated stolons, most of these terminated by a globose tuber; culms terete, 50–200 cm. tall, 2–8 mm. thick, empty and transversely septate, glaucous to shining deep green, clothed at base with a purplish membranous sheath truncate at orifice; spike cylindric, 2–6 cm. long, 3–6 mm. broad, terete, obtuse at apex, glaucous to straw-colored, many-flowered; glumes subdensely imbricated, oblong to oblong-obovate, 4–6 mm. long, 2–3 mm. broad, thickly herbaceous, obtuse at apex, the obtuse median area with a distinct midvein and many slender veins; achenes obovate to broadly so, thickly biconvex, 1.5–2 mm. long, 1–1.5 mm. broad, maturing shining brown, weakly cancellate by hexagonal epidermal cells, the apex with an inconspicuous annular thickening, the style base deltoid, about 2/3 as broad as the achene apex; style 2- or 3-fid; hypogynous bristles 6–8, as long as to nearly twice as long as the achene body, retrorsely scabrous; stamens 3.

LECTOTYPIFICATION AND NOMENCLATURE: As the lectotype of *Andropogon dulce*, Merrill in 1917 indicated *Cyperus dulcis* Rumph. Herb. Amb. 6: 7. t. 3, fig. 1. 1750; lectotypification was necessary because Burman also cited "Plukn. phyt. 175. t. 190. f. 6." *Scirpus plantaginoides* was based on a plant sent to König from Malabar, India. Presumably "*plantagineus*" was a variation of Rottbøll's epithet.

DISTRIBUTION: Tropical West Africa and Madagascar to southern Asia and Japan, Micronesia, Malesia, northern Australia and eastward in the Pacific to Samoa and Tonga; there is no indication that Fiji, Samoa, and Tonga are beyond the indigenous range. The species is cultivated in Hawaii. In Fiji it was first obtained by Seemann in 1860; it occurs from near sea level to 825 m., in swamps and rooting in the mud of shallow lakes and ponds to a depth of 1 m. Flowers and fruits have been observed from July to December.

LOCAL NAMES AND USES: *Kuta*; *sasa*; *taria*. The culms are dried and woven into mats of fine quality. A cultivar of this species bears brownish purple tubers up to 4 cm. in diameter, which provide a nutritious delicacy in Chinese cooking and are usually called *Chinese waterchestnuts*. This cultivar with large tubers has not yet been noted in Fiji.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Lautoka, *Greenwood 439*. NANDRONGA & NAVOSA: Northern portion of Rairaimatuku Plateau between Nandrau and Rewasau, *Smith 5389*; Tonuve, Mbemana district, *H. B. R. Parham 197*. SERUA: Ndeumba, west of Navua, *DA 9196 (McKee 2759)*; Naitonitoni, Navua, *DA 8647*. "MOTURIKI, MBUA (VANUA LEVU), etc.": *Seemann 678*. VANUA LEVU: MATHUATA: Seangangga Plateau, in drainage of Korovuli River, vicinity of Natua, *Smith 6887*. FIJI without further locality, *DA 3704*.

3. *Eleocharis geniculata* (L.) Roemer & Schultes, *Syst. Veg.* 2: 150. 1817; Svenson in *Rhodora* 41: 50. 1939; Greenwood in *J. Arnold Arb.* 25: 403. 1944, in op. cit. 30: 83. 1949; J. W. Parham in *Dept. Agr. Fiji Bull.* 35: 150. 1959; Yuncker in *Bishop Mus. Bull.* 220: 71. 1959; T. Koyama in *Micronesica* 1: 79. 1964; J. W. Parham, *Pl. Fiji Isl.* 298. 1964, ed. 2. 393. 1972; Kern in *Fl. Males.* 1. 7: 536. 1974.

Scirpus geniculatus L. Sp. Pl. 48. 1753.

Small annual; culms tufted, with fibrous roots only, slender but subrigid, 5–30 cm. tall, up to 1 mm. broad, glaucous-green, clothed at base with usually purplish-tinged membranous sheaths; spike ovoid-globose or globose, 4–8 mm. long, about 3 mm. across, terete, obtuse at apex, densely many-flowered; glumes broadly ovate to suborbicular, 1.7–2 mm. long, about 1.5 mm. broad, obtuse or rounded to apex, membranous, rusty-brown and purplish-tinged on both sides, the greenish 1-nerved keel not prominent; achenes obovate, biconvex, 0.8–0.9 mm. long, about 0.75 mm. broad, shining black; style base depressed-conical; style 2-fid; hypogynous bristles 6–8, slightly overtopping achene, sparingly retrorsely spinulose; stamens 2 or 3.

LECTOTYPIFICATION AND NOMENCLATURE: Svenson, in the 1939 reference indicated above, gives the full synonymy of this species, which in America has often passed as *Eleocharis caribaea* (Rottb.) S. F. Blake. As lectotype of *Scirpus geniculatus* Svenson chose a specimen in *Hortus Cliffortianus*, but he did not indicate a country of origin.

DISTRIBUTION: Widespread in tropical and subtropical regions of both hemispheres. In Fiji it is a naturalized adventive but apparently not common, occurring between sea level and 200 m. in low-lying wet areas near coasts, often in coral sand, or in forest in rocky places. When found, it is usually in flower or fruit. It was already established at the time of *H. M. S. Herald's* visit in 1854, but apparently Seemann did not note the collections of MacGillivray and Milne at k.

AVAILABLE COLLECTIONS: VITI LEVU: NANDRONGA & NAVOSA: Thuvu, near Singatoka, *Greenwood 925*. RA: Yanggara, *DA 11863*. VITI LEVU without further locality, *MacGillivray 22*. KANDAVU: Namalata, *DA 2996*. OVALAU: Wainisavulevu, Lovoni, *DA 14512*; Ovalau without further locality, *Milne 223*. NGAU without further locality: *Milne 178*. KANATHEA: *DA L.14761*. FIJI without further locality, *DA 3707*.

8. *Fimbristylis* Vahl, *Enum. Pl.* 2: 285. 1805 or 1806; Seem. *Fl. Vit.* 317. 1868; Kern in *Blumea* 8: 110. 1955, in *Fl. Males.* 1. 7: 540. 1974. *Nom. cons.*

Small to medium-sized perennials or annuals, with slender culms and leaves at base; leaves with elongated blade or reduced to bladeless sheaths, the blades mostly flattish, rarely becoming ensiform; inflorescence a terminal umbelliform corymb, occasionally congested in a head or reduced to a single terminal spikelet, subtended by 1–few leafy bracts; spikelets mostly ovoid, terete or more or less laterally compressed; glumes many, spirally imbricated or all or some 2-ranked, all alike and bearing a bisexual flower at axil; flowers without perianth; stamens 2 or 3; achenes trigonous or lenticular, smooth or cancellate, bearing a stipelike or inconspicuous gynophore, the style filiform or dorsiventrally flattened, the latter type often with fimbriate margins, the style base thickened and jointed at base, hence falling apart from mature achene; stigmas 3 or 2.

TYPE SPECIES: The ICBN indicates as the conserved type of the genus *Fimbristylis dichotoma* (L.) Vahl (*Scirpus dichotomus* L.).

DISTRIBUTION: More than 200 species in both hemispheres, mostly in the tropics and subtropics, with a great concentration of species in tropical Asia. Six species are known to occur in Fiji.

USEFUL TREATMENTS OF GENUS: Kern, J. H. *Florae Malesianae Praecursores X. Notes on Malaysian and some S. E. Asian Cyperaceae III*. *Blumea* 8: 110-169, 1955. Kern, J. H. *Fimbristylis*. *Fl. Males.* 1. 7: 540-592, 1974.

KEY TO SPECIES

Glumes spirally imbricated; inflorescences corymbose, with several to many spikelets.

Stigmas consistently 3; achenes triquetrous or trigonous; styles filiform.

Leaves surrounding culm base all bladed, the blades dorsiventrally flattened; spikelets oblong.

1. *F. complanata*

Leaves at culm base (uppermost 2 or 3) bladeless, the blades of other leaves bilaterally flattened and ensiform; spikelets globular. 2. *F. mihlaca*

Stigmas 2, occasionally 3 in *F. cymosa*; styles not filiform.

Styles hardly flattened, glabrous; achenes maturing dark brown to blackish. 3. *F. cymosa*

Styles flattened, fimbriate at least below stigmas; achenes maturing cream-colored to light orange.

Leaves with a ligule or a fringe of pubescence; styles not bearded at base; achenes trabeculate.

4. *F. dichotoma*

Leaves without a ligule; styles bearded at base with long silky hairs covering apex of achene; achenes smooth or nearly so. 5. *F. squarrosa*

Glumes, at least lower ones, 2-ranked; inflorescences reduced to 1 or 2 spikelets only. 6. *F. ovata*

1. *Fimbristylis complanata* (Retz.) Link, Hort. Reg. Bot. Berol. 1: 292. 1827; Greenwood in Proc. Linn. Soc. 154: 105. 1943; J. W. Parham in Dept. Agr. Fiji Bull. 35: 150. 1959, Pl. Fiji Isl. 298. 1964, ed. 2. 393. 1972; Kern in Fl. Males. 1. 7: 548. 1974.

Scirpus complanatus Retz. Obs. Bot. 5: 14. 1788.

Fimbristylis stricta sensu Seem. in Bonplandia 9: 261. 1861, Viti, 444. 1862; non Labill.

Fimbristylis communis sensu Seem. Fl. Vit. 318. 1868; non Kunth.

Fimbristylis diphylla sensu Drake, Ill. Fl. Ins. Mar. Pac. 332, quoad spec. vit. 1892; non Vahl.

Fimbristylis autumnalis var. *complanata* Kükenth. in Bot. Jahrb. 59: 6. 1924; Yuncker in Bishop Mus. Bull. 220: 71. 1959.

Polymorphic perennial; rhizome horizontal or at times short, clothed with brown fibers; culms closely arranged in a row along rhizome or more or less tufted, markedly flattened-trigonous, 30-70 cm. tall, 2-5 mm. broad, stiff, glabrous, smooth, narrowly winged above at least below corymb, clothed at base with a few sheaths; leaves few to a culm, the blades shorter than culm, flat, 3-5 mm. broad, stiffly herbaceous, blunt at apex, scabrid on upper margins; sheaths laterally compressed with sharply keeled back, the ventral membranous side rusty-colored, obliquely truncate at orifice; ligule a fringe of short pubescence; corymbs compound or decompound, 4-10 cm. long, 3-6 cm. broad, subloose to subdense; rays 2-5, 1-7 cm. long, flattened, scabrid; leafy bracts 2-4, the lowest one suberect, shorter than corymb; spikelets small, oblong to lance-ovate, 4-9 mm. long, 1-2 mm. broad, abruptly acute at apex, rusty-brown, subloosely 5-15-flowered; glumes ovate, 2.5-3 mm. long, abruptly contracted to a mucronate apex, chartaceous, rusty-brown, 1-keeled, the keel green, projecting into a short cusp; achenes broadly obovate, trigonous, about 1.5 mm. long, milky-white, finely cancellate with several rows of transversely oblong epidermal cells; style slender, about 1 mm. long, not ciliate; stigmas 3, as long as style; anthers about 1 mm. long.

TYPEFIICATION: The type of *Scirpus complanatus* was sent from India by König.

DISTRIBUTION: A pantropical species, its range extending northward as far as Japan in eastern Asia. In Fiji it occurs infrequently as a naturalized adventive,

occurring in wet pastures and in other wet places on open slopes, at elevations from near sea level to 800 m.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Lautoka and vicinity, *Greenwood 173*, 279; slopes of escarpment north of Nandariatu, *Smith 6258*. OVALAU: *Milne 272*. WAKAYA: *MacGillivray s. n.*, *Milne 396*. VANUA LEVU: THAKAUNDROVE: Maravu, near Salt Lake, *Degener & Ordonez 14221*. TAVEUNI: *Seemann 675*.

2. *Fimbristylis miliacea* (L.) Vahl, Enum. Pl. 2: 287, as *F. miliaceum*. 1805 or 1806; *Greenwood* in Proc. Linn. Soc. 154: 105. 1943, in J. Arnold Arb. 30: 83. 1949; J. W. Parham in Dept. Agr. Fiji Bull. 35: 150. 1959, Pl. Fiji Isl. 298. 1964, ed. 2. 393. 1972; Kern in Fl. Males. I. 7: 552. 1974.

Scirpus miliaceus L. Syst. Nat. ed. 10. 868. 1759.

Fimbristylis littoralis Gaud. Voy. Uranie et Physicienne, Freycinet, Bot. 413. 1829; S. T. Blake in J. Arnold Arb. 35: 217. 1954.

Annual or occasionally apparently biennial, densely tufted, without rhizome; culms 10–50 cm. tall, 1–5 mm. broad below, flattened-4-sided with 2 sharp edges, smooth, glabrous, leaved at base; few upper leaves bladed, the lower leaves cataphylloid; blades laterally compressed, shorter than to surpassing culm, gradually narrowed to a long, acuminate apex, 1–4 mm. broad at base, light green, soft; sheaths laterally flattened, greenish or the lower ones pale or tinged with rusty- or dusky-brown, obliquely truncate at orifice with membranous margins; corymbs ample, decompound, open, subdense to subloose with numerous spikelets, 3–8 cm. long and broad; bracts 2–4, setaceous, 1/2 to 1/3 the length of rays, the dilated base with brown, membranous margins; rays 3–7, unequal, patent, 1–5 cm. long, scabrid; spikelets solitary, ovoid-globular to globular, 1.5–5 mm. long, 1.5–3 mm. broad, rounded at both ends, rusty-brown, densely many-flowered; glumes patent, broadly ovate, 1–1.2 mm. long, obtuse at apex, membranous, reddish brown, broadly white-hyaline on margins, the 3-nerved keel ending below apex; achenes broadly obovate, trigonous, 0.75–1 mm. long, cream-yellow, cancellate with rows of fine, transversely oblong cells, usually sparsely verruculose; style slender, not fimbriate, about 0.7 mm. long; stigmas 3, as long as style; anthers 0.6–0.7 mm. long.

LECTOTYPIFICATION AND NOMENCLATURE: In the Linnaean Herbarium *Scirpus miliaceus* is represented by two sheets, numbered 71.40 and 71.41, presumably both from India. The former, which is marked "*miliaceus*" in Linnaeus's hand, is the same as *Fimbristylis quinquangularis* Kunth, while the latter represents *F. miliacea* (L.) Vahl of common usage. S. T. Blake (1954, cited above) was of the opinion that no. 71.40 should be considered the type of *S. miliaceus*, which consequently would become the correct name for plants commonly passing as *F. quinquangularis*; in that case *F. littoralis* Gaud. would become the correct name for plants commonly passing as *F. miliacea*. On the other hand, Kern (in Taxon 3: 246. 1954) interpreted the two sheets as being syntypes of *S. miliaceus*, because there is no concrete evidence that no. 71.40 was chosen by Linnaeus as the holotype. Kern has chosen no. 71.41 as the lectotype of *S. miliaceus*, so that the traditional and familiar usage of the name *F. miliacea* can be retained. I here follow Kern's typification and take no. 71.41 as the lectotype.

DISTRIBUTION: Tropical and subtropical regions of both hemispheres, extending in eastern Asia to north temperate areas of Japan and China. In Fiji the species is presumably a naturalized adventive, locally abundant and often forming extensive stands in open swampy land or in standing water in drains. It is frequent in rice fields, swampy cultivated areas, and wet pastures. Flowers and fruits are seen throughout the year. In spite of its local abundance, only 22 Fijian collections seem to be available.

REPRESENTATIVE COLLECTIONS: VITI LEVU: NANDRONGA & NAVOSA: Singatoka Experiment Station, DA 1492. SERUA: Flat coastal strip in vicinity of Ngaloa, *Smith* 9408; Ndeumba, west of Navua, DA 9181 (*McKee* 2744A). NAMOSI: Thalia, DA 2848. RA: Mborotu, DA 7879. NAITASIRE: Vinundawa, DA 8398; Adi Cakobau School, Sawani, DA 7635. TAILEVU: Nausori, *Greenwood* 329; Wainimbokasi, DA 10572. REWA: Namboro, DA 5939. VANUA LEVU: MBUA: Ndama River, DA 1582. MATHUATA: Lambasa, *Greenwood* 584. FIJI without further locality, *Horne* 101.

Although *Greenwood* first reported this species from Fiji in 1943, on the basis of his no. 329 (actually collected by R. Veitch in May, 1921), the *Horne* collection suggests that *F. miliacea* was present at least by 1877.

3. *Fimbristylis cymosa* R. Br. Prodr. Fl. Nov. Holl. 228. 1810; Yuncker in Bishop Mus. Bull. 220: 72. 1959; Kern in *Reinwardtia* 6: 39. 1961; J. W. Parham, Pl. Fiji Isl. 298. 1964, ed. 2. 393. 1972; Kern in Fl. Males. I. 7: 557. 1974.

Fimbristylis spathacea sensu J. W. Parham in Dept. Agr. Fiji Bull. 35: 150. 1959; non Roth.

Densely tufted perennial, with short rhizome; culms stiffly erect, 5–60 cm. tall, 1–2 mm. thick, obtusely trigonous, smooth, glabrous, the base clothed with leaf sheaths and their dusky-brown fibrous remnants; leaves radical, many; blades narrowly linear, patent to recurved, much shorter than culm, 1–4 mm. broad, subcoriaceous, flattish to weakly recurved-margined, abruptly contracted at the subobtuse apex, scabrous on upper margins; sheaths not flattened, ventrally membranous, whitish or cinnamon-colored; ligule none; inflorescence varying from a compound open corymb up to 3×5 cm. in size to a head 7–15 mm. in diameter; rays, when present, 2–6, 1–3 cm. long; leafy bracts 1–3, mostly shorter than corymb; spikelets solitary to clustered, oblong-elliptic to ovate-oblong, 3–6 mm. long, 1.5–2.5 mm. broad, obtuse at apex, densely many-flowered, rusty-brown or somewhat grayish brown; glumes tightly imbricated, ovate to broadly ovate, 1–1.3 mm. long, obtuse, membranous, rusty-brown and broadly white-hyaline on margins, 3- or 5-nerved; achenes broadly obovate, 0.75–1 mm. long, obcompressed-trigonous to nearly biconvex, maturing dark brown, almost smooth; style about 1 mm. long, weakly flattened, not fimbriate; stigmas 3, occasionally 2, as long as style; anthers about 1 mm. long.

TIPIFICATION: Brown's material came from the coast of Australia in the vicinity of the Endeavour River.

DISTRIBUTION: Australia, western Malesia, the Pacific Islands; also tropical America. There have been various opinions as to the taxonomy of the *Fimbristylis cymosa* complex (cf. T. Koyama in *Micronesica* 1: 82–84. 1964). I consider *F. spathacea* Roth to be a subspecies, characterized by its more frequently digynous pistil, distributed in the tropical regions of Africa and Asia. The species is presumably indigenous in Fiji, although uncommon and perhaps limited to a single area, occurring on beaches.

AVAILABLE COLLECTIONS: VITI LEVU: NANDRONGA & NAVOSA: Thuvu, west of Singatoka, *Greenwood* 836A; Korotonga, DA 3718; near Komave, DA 16701. FIJI without further locality, DA 3719.

4. *Fimbristylis dichotoma* (L.) Vahl, Enum. Pl. 2: 287, as *F. dichotomum*. 1805 or 1806; J. W. Parham in Dept. Agr. Fiji Bull. 35: 150. 1959; T. Koyama in *Micronesica* 1: 86. 1964; J. W. Parham, Pl. Fiji Isl. 298. 1964, ed. 2. 393. 1972; Kern in Fl. Males. I. 7: 575. 1974.

Scirpus dichotomus L. Sp. Pl. 50. 1753.

Scirpus diphyllus Retz. Obs. Bot. 5: 15. 1788.

Fimbristylis diphylla Vahl, Enum. Pl. 2: 289, as *F. diphyllum*. 1805 or 1806; Christophersen in Bishop Mus. Bull. 128: 20. 1935; Yuncker in op. cit. 184: 26. 1945.

Fimbristylis annua sensu Yuncker in Bishop Mus. Bull. 184: 26. 1945; J. W. Parham in Dept. Agr. Fiji Bull. 35: 150. 1959; non Roemer & Schultes.

Fimbristylis marginata sensu Seem. in Bonplandia 9: 261. 1861, Viti, 444. 1862; non Labill.

Fimbristylis arvensis sensu Seem. Fl. Vit. 318. 1868; J. W. Parham in Dept. Agr. Fiji Bull. 35: 150. 1959; non Vahl.

Fimbristylis ferruginea sensu Drake, Ill. Fl. Ins. Mar. Pac. 332, quoad spec. vit. 1892; J. W. Parham, Pl. Fiji Isl. 298. 1964, ed. 2. 393. 1972; non Vahl.

Fimbristylis annua var. *diphylla* Kükenth. in Bot. Jahrb. 59: 4. 1924; Greenwood in Proc. Linn. Soc. 154: 105. 1943.

Annual, or in warmer regions becoming a biennial or short-lived perennial; culms solitary or subloosely tufted, occasionally with short rhizome, erect, 10–70 cm. tall, 0.5–1.5 mm. thick, trigonous, soft to stiff, smooth, glaucous-green, pilose to glabrous; sheaths tightly surrounding culm, cylindric, pilose to glabrous, the membranous ventral side cinnamon-brown or light brown; ligule a fringe of pubescence; corymbs simple, compound or decompound, 2–8 cm. long, 1–5 cm. broad, loose to subdense; rays 2–5, 1–6 cm. long, slender, smooth, glabrous to sparingly pilose; bracts 2–5, the lower one leafy, shorter than to overtopping the corymb, the others setaceous; spikelets solitary or in clusters of 2 or 3, ovate to ovate-elliptic, 4–8 mm. long, 2.5–3 mm. broad, subacute, terete, brownish to chestnut-brown, slightly shiny, densely many-flowered; glumes broadly ovate, suberect, 2–3 mm. long, contracted to an often mucronate apex, chartaceous, faintly few-nerved on both sides, yellowish and tinged with reddish brown or dark brown especially on upper half, the costa 3-nerved, greenish, forming a mucro at glume apex; achenes broadly obovate, 0.8–1.2 mm. long, biconvex, rounded to apex, short-stipitate at base, whitish to yellowish at maturity, cancellate with 5–8 rows of transversely rectangular cells; style strongly compressed, copiously fimbriate; stigmas 2.

LECTOTYPIFICATION AND NOMENCLATURE: *Scirpus dichotomus* is based upon two collections: Herb. Herman 2. fol. 63, from Ceylon, and Herb. Sloane 96. fol. 83, from an unknown locality (both seen at BM), these being syntypes and representing the same taxon, a common tropical Asian form of *Fimbristylis dichotoma* often called either *F. diphylla* or *F. dichotoma* var. *floribunda*. I herewith designate the Ceylonese specimen, Herb. Herman 2. fol. 63 as the lectotype, since this collection better matches the portion of Linnaeus's original description indicating "spicis dichotomiae sessilibus." This choice additionally reflects Linnaeus's statement: "*Habitat in India.*" The type material of *Scirpus diphyllus* (seen in the Botanical Museum at Lund) was sent from the Tranquebar region of India by König; this collection is taxonomically quite identical with the lectotype of *S. dichotomus*. The other records mentioned above, of *Fimbristylis marginata*, *F. arvensis*, and *F. ferruginea*, all seem to be misidentifications ultimately based on Seemann 674, which is here placed in *F. dichotoma* on the basis of its examination at K by Dr. Smith.

DISTRIBUTION: Temperate, subtropical, and tropical zones of the entire world. In Fiji it may be found from near sea level to 1,000 m., in open places, marshes, rocky places in open forest and on ridges, along forest trails, and as a locally abundant weed in cultivated areas, cane fields, and rice fields. It is usually in flower or fruit. It is the most common representative of *Fimbristylis* in Fiji, about 90 collections being available.

LOCAL NAME: *Thondamu* has been recorded from Moala; this simply implies a reddish small plant, and the name is more often used for a species of the grass genus *Opismenus*.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Near Nandi airport, DA 8250; Lautoka, Greenwood 421; Mt. Nanggaranambuluta, east of Nandarivatu, Smith 4762. NANDRONGA & NAVOSA: Near Momi lighthouse, DA 8286. SERUA: Navua, DA 8629. NAMOSI: Wainandoi River, DA 10807. RA: Yanggara, DA 10746; Vaileka, DA 8102. NAITASIRI: Vunindawa, DA 8420; Tholo-i-suva, DA 8967. TAILEVU: Uthunivanua, DA 9252 (McKee 2818); Mbau road, near Kuku, DA 10614. REWA: Namboro,

DA 5938. KANDAVU: Vunisea, DA 2973. OVALAU: Graeffe 1219. NGAU: Milne 177. VANUA LEVU: MATHUATA: Seanggangga Plateau, vicinity of Natua, Smith 6889; Wainikoro, Greenwood 708. THAKAUNDROVE: Savusavu, DA 8869. TAVEUNI: Seemann 674 (duplicates may be from Ovalau). MOALA: Milne 135; Ndelaimoala, Smith 1365. MATUKU: Milne 118. KANATHEA: DA L.14758. FIJI without further locality, U.S. Expl. Exped.

5. *Fimbristylis squarrosa* Vahl, Enum. Pl. 2: 289, as *F. squarrosus*. 1805 or 1806; Kern in Blumea 8: 143. 1955, in Fl. Males. I. 7: 585. 1974.

Small, slender annual, densely tufted; culms slender, 8–25 cm. tall, 0.3–0.5 mm. broad, trigonous, smooth, glabrous, few-leaved at base; leaf blades narrowly linear, 0.7–1 mm. broad, flattish with more or less incurved margins, obtuse at apex, soft, light green, mostly pilose on both surfaces, sometimes glabrescent; sheaths 0.5–3 cm. long, pale green or brownish, pubescent, rarely glabrescent; corymbs compound, loose to subdense, 2–4 cm. long and broad; rays filiform, 3–7, 1–3 cm. long; bracts 3–5, setaceous, shorter than rays; spikelets solitary, ovate to lance-ovate, 3–6 mm. long, 2.5–3 mm. broad, subterete, subdensely 7–18-flowered, yellow- or orange-brown; glumes imbricated, narrowly ovate or elliptic, 1.5–2 mm. long, membranous, pale and tinged with brownish orange or yellow, the 3-nerved green keel projecting beyond glume apex, forming a recurved awn 0.7–1 mm. long; achenes obovate, thickly biconvex, about 1 mm. long, rounded at apex, short-stipitate at base, yellow or orange-yellow, smooth and sometimes slightly shiny; style 1.2–1.5 mm. long, filiform, weakly flattened, ciliolate above, the dilated base pilose with long, white, silky, pendant hairs 1, 2 to 2/3 the length of achene; stigmas 2, about 1 mm. long.

TYPEFICTION: Vahl's type (seen at C) is cited by him as: "Habitat in America meridionali. Ex herbario antiquo, forte Loefflingii, matriti habui."

DISTRIBUTION: In spite of Vahl's indication, the type was probably from India. The species occurs in tropical Africa, South America, tropical and warm temperate Asia (from India to Japan), and eastward to the Pacific Islands. It is found in wet places, in some areas being abundant in rice fields. However, in Fiji it is known from a single collection, obtained in shallow water at the edges of a pond, and in flower and fruit in November and December.

AVAILABLE COLLECTION: VANUA LEVU: MATHUATA: Seanggangga Plateau, in drainage of Korovuli River, vicinity of Natua, Smith 6661.

6. *Fimbristylis ovata* (Burm. f.) Kern in Blumea 15: 126. 1967, in Fl. Males. I. 7: 565. 1974.

Carex ovata Burm. f. Fl. Ind. 194. 1768.

Cyperus monostachyos L. Mant. Pl. Alt. 180. 1771.

Fimbristylis monostachyos Hassk. Pl. Jav. Rar. 61, as *F. monostachya*. 1848; T. Koyama in Micronesica 1: 91. 1964; J. W. Parham, Pl. Fiji Isl. 298. 1964, ed. 2. 393. 1972.

Fimbristylis monostachya Hassk. ex Greenwood in Proc. Linn. Soc. 154: 105. 1943; J. W. Parham in Dept. Agr. Fiji Bull. 35: 150. 1959; Yuncker in Bishop Mus. Bull. 220: 72. 1959.

Subloosely tufted perennial, with short rhizome; culms slender, 10–40 cm. tall, 0.5–0.8 mm. thick, angular; leaf blades slenderly linear, 1/2 to 2/3 the length of culm, flattish with more or less incurved margins, 0.5–1.2 mm. broad, glabrous, blunt at apex; sheaths 1–3 cm. long, yellowish brown, eventually disintegrating into fibers; inflorescence a single, terminal spikelet; bracts 2 or 3, scalelike, or the lowest bract with a setaceous extension of midvein about 1 cm. long; spikelet ovate, subacute at apex, weakly laterally flattened with obtuse angles, 8–15 mm. long, 4–7 mm. broad, glaucous-yellow or yellow-green; lower glumes 2-ranked, the upper ones becoming imbricated, ovate or broadly ovate, boat-shaped, with an acute keel, 3–6 mm. long, acute at apex, chartaceous, yellowish, weakly shiny, the 3-nerved green costa ending in a mucro at glume apex; achenes broadly obovate, 2–3 mm. long, trigonous, contracted at apex, short-stipitate at base, white, somewhat bony, verru-

culose; style about 2 mm. long, ciliate above, thickened at base; stigmas 3, as long as style.

TYPEIFICATION AND NOMENCLATURE: The holotype of *Carex ovata*, according to Kern, is a specimen at G from Java, annotated in Burman's handwriting. Therefore the name *Fimbristylis ovata* must replace *F. monostachyos*; the basionym of the latter, *Cyperus monostachyos*, was based on a König specimen, probably from Ceylon.

DISTRIBUTION: Tropical and subtropical regions of both hemispheres. In Fiji the species is not common; it is found from near sea level to 900 m. on dry, open hill-sides, in pastures, and in rocky places in thin forest. Flowers and fruits have been seen in scattered months.

LOCAL NAME AND USE: *Ndondombawale*; used in garlands. This information comes only from the Waya Island specimen cited below.

AVAILABLE COLLECTIONS: YASAWAS: WAYA: Olo Creek, north of Yalombi, *St. John 18129*. VITI LEVU: MBA: Lautoka, *Greenwood 189*; Sambeto Valley, *DA 8282*; northern slopes of Mt. Name-ndre, east of Mt. Koromba, *Smith 4509*. RA: Ellington, *DA 7899*. OVALAU: *Milne 279*. VANUA LEVU: MATHUATA: Southern base of Mathuata Range, north of Natua, *Smith 6799*. THAKAUNDROVE: Maravu, near Salt Lake, *Degener & Ordenez 14224*. MATUKU: *Tothill 292*. VANUA MBALAVU: *Tothill 168*; central volcanic section, near Lomaloma, *Smith 1426*. OLORUA: *Bryan 519a*. FIJI without further locality, *Milne s. n.*

9. CYPERUS L. Sp. Pl. 44. 1753; Kükenth. in Pflanzenr. **101** (IV. 20): 41. 1935.

Annuals or perennials, occasionally with short or elongated rhizomes; culms leaved only at base; leaves usually with elongated blade, dorsiventrally flattened, rarely reduced to bladeless sheaths; inflorescence a terminal umbelliform corymb with several rays, sometimes congested in the head, subtended by few to several leafy bracts; spikelets spicately or digitately disposed in spikes, each with few to many glumes as a rule 2-ranked on a continuous rhachilla, this prophyllate at base; glumes all similar, bearing an axillary bisexual flower, the base sometimes decurrent along angles of rhachilla and then the rhachilla-internodes winged; flowers without hypogynous bristles, consisting of a pistil and 1-3 stamens; achenes trigonous or more or less dorsiventrally flattened; style not jointed at base; stigmas 3, sometimes 2.

LECTOTYPE SPECIES: Of the 15 species originally placed in *Cyperus* by Linnaeus, there is a consensus (not yet indicated by ING) to take *C. esculentus* L. as the lectotype species.

DISTRIBUTION: A worldwide genus of many species, even as usually restricted (to exclude *Mariscus*, *Torulinium*, *Pycnus*, and *Kyllinga*) by many recent students.

USEFUL TREATMENTS OF GENUS: Kükenthal, G. Cyperaceae-Scirpoideae-Cypereae. Pflanzenr. **101** (IV. 20): 1-160. 1935, 161-671. 1936. Kern, J. H. Cyperus. Fl. Males. I. 7: 592-661. 1974. These basic works treat *Cyperus* in an inclusive sense, by the standards of generic limitation here adopted.

KEY TO SPECIES

Spikelets spicately disposed on elongated rhachis of spike.

Plants perennial, with conspicuous rhizomes; base of floral glumes usually decurrent along angles of rhachilla, the rhachilla-internodes winged (except in no. 3, with indistinct wings).

Leaves reduced to bladeless sheaths; corymbs with numerous rays; culms 1.5-2 m. tall. 1. *C. papyrus*

Leaves with elongated blade; corymbs with several rays; culms 20-100 cm. tall.

Rhizome short, cormlike; glumes obtuse at apex. 2. *C. distans*

Rhizome stoloniferous; glumes acute at apex.

Rhachis of spikes hirsute; rather robust plants with culms 5-8 mm. thick and 30-85 cm. tall; leaves 6-8 mm. broad. 3. *C. pilosus*

Rhachis of spikes glabrous; slender plants with culms 1-2 mm. thick and as a rule 10-30 cm. tall; leaves 2-5 mm. broad. 4. *C. rotundus*

Plants annual, with fibrous roots only; base of floral glumes not at all decurrent, hence rachilla-inter-nodes not winged at all.

Spikelets lance-oblong, 2.5–3 mm. broad; glumes 3–3.5 mm. long.5. *C. compressus*

Spikelets linear, 1–2 mm. broad; glumes 1–1.5 mm. long.6. *C. iria*

Spikelets digitately disposed at apices of corymb rays or raylets; spikes without a conspicuous rachis.

Plants tall, with culms 60–150 cm. tall; corymbs with many leafy bracts, all of equal length and surpassing the corymb rays.7. *C. alternifolius*

Plants small to medium-sized, with culms 10–40 cm. tall; corymbs with 1–few leafy bracts, these very unequal in length.

Spikelets many, densely congested, forming glomerules 5–15 mm. across; glumes orbicular, rounded at apex; annuals, with fibrous roots only.8. *C. difformis*

Spikelets 4–8 to a cluster, digitate at apices of rays and/or raylets; glumes oblong or lance-elliptic, mucronate at apex; short-lived perennials, often with elongated rhizome.9. *C. haspan*

1. *Cyperus papyrus* L. Sp. Pl. 47. 1753; Kükenth. in Pflanzenr. **101** (IV. 20): 45. 1935; J. W. Parham, Pl. Fiji Isl. ed. 2. 392. 1972.

Luzula campestris sensu J. W. Parham in Dept. Agr. Fiji Bull. **35**: 148. 1959, Pl. Fiji Isl. 295. 1964; non DC.

Tall perennial, with woody, short-decumbent rhizome; culms loosely tufted along rhizome, 1–5 m. tall, 1–3 cm. thick below, obtusely trigonous, naked with a few bladeless sheaths at base; the basal sheaths coriaceous, brown, obliquely truncate at orifice; the sterile shoots sometimes bearing short-bladed leaves; corymb ample; bracts 4–10, narrowly lanceolate, much shorter than corymb rays; rays numerous, 10–30 cm. long, all nearly equal in length, slender; prophyll at base of rays 3 cm. long; secondary corymbs bearing 3–5 slender raylets and 3–5 bracteoles; spikes cylindric, 1–2 cm. long, 6–9 mm. broad, subdensely bearing many spikelets; spikelets linear, 6–10 mm. long, about 1 mm. broad, bearing 6–20 flowers; rachilla winged with lanceolate base of glumes; body of glumes ovate-elliptic or elliptic, obtuse, pale brownish and green on midvein; achenes oblong, trigonous, obtuse at apex, maturing brownish; style 3-fid; stamens 3.

TYPIFICATION AND NOMENCLATURE: Linnaeus cited several prior references, adding: “*Habitat in Calabria, Sicilia, Syria, Aegyptio.*” *Luzula campestris* var. *flaccida* Buchenau (in Pflanzenr. **25** (IV. 36): 92. 1906) was mentioned by Buchenau from Fiji as collected by Atkinson on Hunter’s Island. This must certainly refer to Hunter’s Island off the northwest coast of Tasmania; E. Atkinson, who collected in Tasmania, is not known to have visited Fiji, where there are no authentic records of the occurrence of the family Juncaceae. Probably Buchenau’s mention of Fiji influenced Parham’s misidentification.

DISTRIBUTION: Native in eastern tropical Africa and Madagascar, but widely cultivated elsewhere as an ornamental in greenhouses and water gardens. It was introduced into Fiji early in the present century and is said to be moderately common in cultivation and also naturalized in ponds and swampy places, although its occurrence is supported by only one collection.

LOCAL NAME AND USE: *Umbrella plant*; the name *papyrus*, usually applied to this showy sedge as a common name, seems not to be used in Fiji. Its use is as an ornamental in wet gardens.

AVAILABLE COLLECTION: VITI LEVU: NAITASIRE: Opposite entrance to Ndavuilevu, DA 13197.

2. *Cyperus distans* L. f. Suppl. Pl. 103. 1781; Kükenth. in Pflanzenr. **101** (IV. 20): 137. 1935; Greenwood in J. Arnold Arb. **30**: 82. 1949; J. W. Parham in Dept. Agr. Fiji Bull. **35**: 152. 1959; T. Koyama in Micronesica **1**: 93. 1964; J. W. Parham, Pl. Fiji Isl. 297. 1964, ed. 2. 391. 1972; Kern in Fl. Males. **1**: 7: 610. 1974.

Perennial, with small cormlike rhizome; culms solitary or few together, often rather slender, 35–100 cm. tall, triquetrous, thickened at base; leaves shorter than culm; blades linear, 4–6 mm. broad, weakly folded, herbaceous; sheaths rather elongated, light brown; corymb compound to decompound; leafy bracts 4–6, the lower 2 or 3 surpassing the corymb; rays 5–10, 1–15 cm. long, patent; secondary corymbs with short raylets or bearing 4–8 subsessile spikes; spikes loose, broadly ovate in outline, distantly bearing 8–20 spikelets; spikelets divergent, linear, 8–40 mm. long, 0.8–1 mm. broad, cylindric, 8–32-flowered; glumes distantly disposed on a weakly zigzag rhachilla, elliptic, 1.8–2 mm. long, obtuse at apex, membranous, sanguineous-brown on both sides, 3–5-nerved near keel, white-hyaline on upper margin, the keel greenish, hardly reaching the glume apex, the base decurrent along rhachilla, forming caducous white-hyaline wings; achenes oblong to oblong-elliptic, 3-sided, about $2/3$ as long as glume, maturing dark brown, minutely punctulate; style short; stigmas 3; stamens 3.

TIPIFICATION: *Cyperus distans* was based on *Cyperus elatus* sensu Rottb. Descr. Icon. Rar. Pl. 37. t. X. 1773; non L. Rottbøll's excellent plate is readily identifiable as *C. distans*; the material upon which it was based came from Malabar, India.

DISTRIBUTION: A pantropical species, probably a naturalized adventive in Fiji, where it occurs near sea level on roadsides and cultivated land and in pastures; in Fiji it is known from comparatively few collections, probably all from Viti Levu.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Navo, Nandi, *Greenwood* 756. NAITASIRI: Vunindawa, *DA* 8449; Waindravu, *DA* 9931; Navuso, *DA* (coll. *Raiqiso*), Nov. 1934; Wainimbuku, *DA* 8683; Nanduruloulou, *DA* 3806. TAILEVU: Korovou, *DA* 7677; Nakaila, *DA* 8612; near Nausori, *Greenwood* 1104. REWA: Lomanikoro, *DA* 428. FIJI without further locality, *DA* 3716.

3. *Cyperus pilosus* Vahl, Enum. Pl. 2: 354. 1805 or 1806; Kükenth. in Pflanzenz. 101 (IV. 20): 92. 1935; J. W. Parham in Dept. Agr. Fiji Bull. 35: 153. fig. 78, a. 1959; T. Koyama in Micronesica 1: 94. 1964; J. W. Parham, Pl. Fiji Isl. 297. 1964, ed. 2. 392. 1972; Kern in Fl. Males. I. 7: 611. fig. 52. 1974.

Annual or short-lived perennial; rhizome stoloniferous, the stolons slender, elongated, soft, distantly clothed with pale brown scales; culms solitary or few together, erect, 25–85 cm. tall, acutely triquetrous, 0.3–0.5 cm. broad, smooth or scabrid on angles below corymb; leaves few to several to a culm, shorter than culm; blades broadly linear, flattish, 6–8 mm. broad, rather soft; sheaths short, pale greenish to pale brownish, withering without disintegrating into fibers; corymbs ample, compound to decompound, with 3–10 rays of unequal length; rays patent, thickish, 2–14 cm. long; secondary corymbs with 2–5 raylets 0.5–2 cm. long; spikes subpyramidal, subdense, 2–3 cm. long, 1–2 cm. broad, the rhachis subdensely hirsute with yellow-brown short hairs; spikelets spreading, linear-lanceolate, 5–15 mm. long, 1.5–2.5 mm. broad, slightly swollen, 8–25-flowered, straw-colored and tinged with red-brown; rhachilla without wings; glumes subloosely disposed, broadly deltoid-ovate, acute at the often mucronulate apex, 1.8–2.2 mm. long, thin-chartaceous to membranous, pale straw-colored and tinged or flecked with reddish brown, whitish-hyaline on margins, rather distinctly 5- or 7-nerved; achenes broadly elliptic to obovate, 3-sided, $1/2$ to $2/3$ as long as glume, dark brown at maturity; stigmas 3; style short; stamens 3.

TIPIFICATION: Vahl indicates only that his material came from "India orientalis."

DISTRIBUTION: Widespread from tropical West Africa through central Asia and India to Japan, eastward to Malesia and northern Australia. In Fiji it is a naturalized adventive, occurring near sea level along roadsides, in swamps and wet places along rivers, and in coconut plantations, pastures, cane fields, and rice fields. It is in flow-

er and fruit at any season. According to Parham it was not noted in Fiji prior to 1952; about 25 collections are now available.

REPRESENTATIVE COLLECTIONS: VITI LEVU: SERUA: Ndeumba, *DA 8634*; Navua, *DA 11449*; Tokotoko (and into adjacent Namosi Province), *DA 9439*. NAMOSI: Wainandoi River, *DA 10809*. NAITASIRI: Vinindawa, *DA 10015*; Sawani, *DA 7622*; Mbatiki, *DA 7403*; Nanduruloulou, *DA 8379*. TAILEVU: Nakaile, *DA 8615*; Mbau road, near Kuku, *DA 10616*; Wainimbokasi, *DA 10576*. TAVEUNI: Waitavala, *DA 8890*.

4. *Cyperus rotundus* L. Sp. Pl. 45. 1753; A. C. Barnes in Agr. J. Dept. Agr. Fiji 3: 112. 1930; Kükenth. in Pflanzenr. **101** (IV. 20): 107. fig. 13. 1935; Christophersen in Bishop Mus. Bull. **128**: 16. 1935; B. E. V. Parham in Agr. J. Dept. Agr. Fiji **11**: 101. 1940; Greenwood in Proc. Linn. Soc. **154**: 105. 1943; Yuncker in Bishop Mus. Bull. **178**: 26. 1943; J. W. Parham in Agr. J. Dept. Agr. Fiji **19**: 103. 1948, in Dept. Agr. Fiji Bull. **35**: 150. fig. 75. 1959; Yuncker in Bishop Mus. Bull. **220**: 70. 1959; T. Koyama in Micronesica **1**: 93. 1964; J. W. Parham, Pl. Fiji Isl. 297. 1964, ed. 2. 392. 1972; Kern in Fl. Males. **1**: 7: 604. fig. 49. 1974.

Perennial, with long, slender, stoloniferous rhizome terminated by a globose-ovoid tuber; culms solitary or few together, bearing a cormlike enlargement at base, erect, 10–40 (rarely up to 60) cm. tall, slender, triquetrous, smooth, with leaves at base; leaves few, much shorter than culm; blades linear, 2–5 mm. broad, folded; sheaths light brownish, eventually disintegrating into brown parallel fibers; corymbs simple to compound, loose, with 2–10 slender rays of unequal length; rays 1–8 (–12) cm. long, patent; spikes turbinate with rather short rhachis, subloosely bearing 3–10 spikelets; leafy bracts usually 2 or 3, rarely up to 5, the lowest 2–3 times as long as the corymb, the second slightly surpassing the corymb, the remaining bracts setaceous; spikelets spreading, linear, 1–3 cm. long, (1.5–) 2–3 mm. broad, subcompressed, with acute edges, subdensely 8–28-flowered, sanguineous-brown; rhachilla with relatively broad, white-hyaline wings; glumes ovate to ovate-elliptic, 3–3.2 mm. long, folded, with subacute keel, membranous, sanguineous- or purple-brown, 5- or 7-nerved with weak lateral veins, the apex obtuse or abruptly mucronate, more or less recurved, the keel greenish; achenes oblong, 3-sided, 1/3 to 2/5 the length of glume, maturing brown, minutely punctulate; style elongate; stigmas 3; stamens 3.

TYPEFICATION: Linnaeus cited three prior references; presumably his material came from India or Ceylon.

DISTRIBUTION: Temperate and tropical regions of the world. In Fiji it is an abundant naturalized weed, occurring near sea level on cultivated land, along roadsides, on plantations and in cane fields, as well as along the seashore. It is a serious weed in tobacco and vegetable cultivation and is difficult to eradicate. It was first reported in Fiji by Barnes in 1930 and is much more abundant than the approximately 20 available collections imply. On the other hand, in China and Japan this species has long been known as a natural drug with antifebrile properties because of the existence of cyperene and cyperinerol in the tubers.

LOCAL NAMES: *Nut grass*; *vuthesa*; *soronakambani*; *soranakambani*; *malanga*; *mot ha*.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Nandi, *DA 8549*; Lautoka, *Greenwood 415*; Tavua, *DA 8186*. SERUA: Naitonitoni, Navua, *DA 8650*. RA: Ellington, *DA 7908*. NAITASIRI: Nawanggambena, *DA 701*; Nasinu, *DA 11087*. TAILEVU: Mbuthalevu, Wainimbuka River, *DA 10957*. KANDAVU: Ngaloa Island, *DA 9076*. VANUA LEVU: MATHUATA: Nakamba, *DA 8734*. THAKAUNDROVE: Savusavu, *DA 8852*. TAVEUNI: Vatuwiri, *DA 8913*; Waiyevo, *DA 5733*.

5. *Cyperus compressus* L. Sp. Pl. 46. 1753; Kükenth. in Pflanzenr. **101** (IV. 20): 156. fig. 4, A–D. 1935; Christophersen in Bishop Mus. Bull. **128**: 15. 1935; Green-

wood in Proc. Linn. Soc. **154**: 105. 1943; Yuncker in Bishop Mus. Bull. **184**: 25. 1945; Greenwood in J. Arnold Arb. **30**: 82. 1949; J. W. Parham in Dept. Agr. Fiji Bull. **35**: 152. 1959; Yuncker in Bishop Mus. Bull. **220**: 68. 1959; T. Koyama in Micronesica **1**: 94. 1964; J. W. Parham, Pl. Fiji Isl. 296. 1964, ed. 2. 391. 1972; Kern in Fl. Males. I. **7**: 617. 1974.

Tufted annual, with fibrous roots only; culms patent, 8–35 cm. tall, relatively stout, 3-sided, smooth; leaves few to a culm, basal; blades linear, flat, 1–3 mm. broad, shorter than culms, light green; sheaths membranous, pale brownish, striate; inflorescence umbelliform or congested, 2–10 cm. long and broad; involucre bracts 2–4, leaflike, unequal in length, the longest one 2 or 3 times as long as inflorescence; rays when present 2–5, patent, 0.8–5 cm. long, slightly compressed; spike bearing 3–10 spikelets on abbreviated axis, oval or somewhat flabelliform, 3 cm. long; spikelets lance-oblong, 10–25 mm. long, 2.5–3 mm. broad, 15–40-flowered, compressed, greenish and turning straw-colored at full maturity; rhachilla not winged; glumes ovate or broadly so, 3–3.5 mm. long, herbaceous or thin-coriaceous, strongly folded with acute keel, 3-nerved on both sides, the keel green, finely many-veined, the apex acute, with a straight mucro about 0.8 mm. long; achenes 1–1.25 mm. long, broadly obovate, 3-sided, dark brown, shiny, minutely punctulate; style elongated, 3-fid at apex.

TIPIFICATION: Giving several prior references, Linnaeus indicated that his species came from North America.

DISTRIBUTION: Pantropical, the range in eastern Asia extending northward to central Japan. In Fiji it is a naturalized adventive, found near sea level in standing water and damp places, along rivers, on seashores, and in coconut plantations. Although it may be locally common, only a few collections have been made. The Greenwood material from Lautoka, first obtained in March, 1919, may represent the earliest record in Fiji.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Lautoka, *Greenwood 168, 168A, 1098*. RA: Rewasa, *DA 8083*. NAITASIRE: Near Nasinu, *Greenwood 1106*. VANUA LEVU: MATHUATA: Lambasa, *Greenwood 585*. THAKAUNDROVE: Namawa Estate, near Savusavu, *DA 8819*. TAVEUNI: McKay's Estate, *DA 8877*.

6. *Cyperus iria* L. Sp. Pl. 45. 1753; Kükenth. in Pflanzenr. **101** (IV. 20): 150. 1935; Greenwood in J. Arnold Arb. **30**: 82. 1949; J. W. Parham in Dept. Agr. Fiji Bull. **35**: 152. 1959; T. Koyama in Micronesica **1**: 94. 1964; J. W. Parham, Pl. Fiji Isl. 297. 1964, ed. 2. 391. 1972; Kern in Fl. Males. I. **7**: 616. 1974.

Annual, with fibrous roots only; culms solitary or a few together, erect, 8–60 cm. tall, slender or slightly thick, trigonous, smooth; leaves 2 or 3 to a culm, much shorter than culm; blades linear, 2–5 mm. broad, weakly folded; sheaths reddish or somewhat purplish brown; corymbs as a rule compound, 5–15 cm. long, 3–10 cm. broad, with 3–7 unequal rays 2–12 cm. long, each bearing 5–10 spikes; spikes often more or less inclined, elliptic-ovate, 1–4 cm. long, bearing 4–20 spikelets; leafy bracts 4 or 5, the lowest 2 or 3 surpassing the corymb; spikelets rather loosely disposed, erect-patent, oblong-elliptic or lanceolate, 4–9 mm. long, 1.7–2 mm. broad, flattened, 6–22-flowered; rhachilla hardly winged; glumes subloosely disposed, obovate-orbicular, 1–1.5 mm. long, truncate to shallowly retuse at the usually mucronulate apex, thinly herbaceous, yellow or slightly straw-colored, pale on hyaline upper margin, 3- or 5-nerved, convex on the green keel; achenes obovate, 3-sided, nearly equalling the glume, maturing dark brown; style short, about $1/3$ as long as achene; stigmas 3; stamens 3.

TIPIFICATION: India, collected by Osbeck.

DISTRIBUTION: East Africa and central Asia through India to China and Japan, eastward to Malesia and Australia; the species is adventive in many other areas, in-

cluding the southeastern United States, the West Indies, and South America. In Fiji it is a naturalized adventive, often locally abundant on Viti Levu from sea level to 300 m., along roadsides and in swamps, cultivated areas, and especially in rice fields. It is seen in fruit and flower at any season and is more abundant than the 14 available collections indicate. Probably Greenwood's observation of it in 1932 (noted in cited 1949 publication) indicates the approximate time of its introduction.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Hills near Lautoka, *Greenwood 806B*. SERUA: Tokotoko area, Navua, *DA 10556*. NAMOSI: Thalia, *DA 2845*. RA: Ndombuilevu, *DA 7818*. NAITASIRE: Sawani-Serea road, *DA 7987*; Wainimbuku, *DA 8685*; Koronivia, *DA 6093*. TAILEVU: Nakaile, *DA 8617*.

7. *Cyperus alternifolius* subsp. *flabelliformis* (Rottb.) Kükenth. in *Pflanzenr.* **101** (IV. 20): 193. 1936; Greenwood in *J. Arnold Arb.* **30**: 82. 1949; J. W. Parham in *Dept. Agr. Fiji Bull.* **35**: 153. 1959; T. Koyama in *Micronesica* **1**: 96. 1964; J. W. Parham, *Pl. Fiji Isl.* 296. 1964, ed. 2. 390. 1972.

Cyperus flabelliformis Rottb. *Descr. Icon. Rar. Pl.* 42. t. 12, fig. 2. 1773; J. W. Parham in *Dept. Agr. Fiji Bull.* **35**: 154, as *Carex f.*, sphalm. 1959.

Cyperus alternifolius sensu Yuncker in *Bishop Mus. Bull.* **178**: 25. 1943, in op. cit. **220**: 68. 1959; non L.

Tall perennial, with short, woody rhizome; culms subdensely tufted, 50–150 cm. tall, obtusely trigonous to nearly terete below, scabrous below the corymb, clothed at base with bladeless sheaths only; basal sheaths pale greenish, 10–20 cm. long, obliquely truncate at orifice, the lower ones cataphylloid, yellow-brown; corymbs ample, subdense, 15–30 cm. across, decompound; primary rays numerous, slender, 7–10 cm. long, each bearing 4–10 raylets 1–1.5 cm. long; leafy bracts many, nearly equal in length, about twice as long as corymb, stiff, flattish, 2–12 mm. broad, subabruptly acute at apex; spikelets clustered at apices of raylets, lance-oblong to elliptic, flattened, 3–9 mm. long, 1.7–3 mm. broad, densely 6–30-flowered, light green; rhachilla not winged; glumes ovate, acute at apex, about 2 mm. long, membranous, pale green and variegated with rusty-brown, 3- or 5-nerved, the keel prominent; achenes ovate-elliptic, 3-sided, 1/3 to 1/4 as long as glume, maturing brown; style nearly as long as achene; stigmas 3, elongated; stamens 3.

TYPE: The original material, from Arabia, was cited by Rottbøll as: "Progr. nostr. 1772, p. 22, N. 57."

DISTRIBUTION: A native of tropical Africa and Arabia, now widely cultivated as an ornamental and often naturalized. This taxon is usually considered a subspecies of *Cyperus alternifolius* L. (Mant. *Pl. Alt.* 28. 1771), native to East Africa and Madagascar. The showy subspecies is probably a fairly recent introduction into Fiji; it has become a naturalized adventive occurring near sea level in wet places and along roadsides.

LOCAL NAME AND USE: *Umbrella plant*, the usual horticultural name, has not been noted in Fiji, but the plant is sometimes used as an ornamental in water gardens.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Koroivulu, Nandi, *DA 10891*. NAMOSI: Lower Navua River, *Greenwood 985*. NAITASIRE: Mbatiki, *DA 1210*; Ndavuilevu, *DA L.11695*. TAILEVU: Londoni Landing, *DA 10848*.

8. *Cyperus difformis* L. *Cent. II. Pl.* 6. 1756; Kükenth. in *Pflanzenr.* **101** (IV. 20): 237. fig. 27, F–H. 1936; Greenwood in *Proc. Linn. Soc.* **154**: 105. 1943, in *J. Arnold Arb.* **30**: 82. 1949; J. W. Parham in *Dept. Agr. Fiji Bull.* **35**: 153. 1959; T. Koyama in *Micronesica* **1**: 95. 1964; J. W. Parham, *Pl. Fiji Isl.* 297. 1964, ed. 2. 391. 1972; Kern in *Fl. Males.* **1**: 7: 629. 1974.

Annual, with purple fibrous roots, tufted in small or often relatively large clumps; culms erect to erect-patent, (10–) 25–60 cm. tall, acutely triquetrous with concave sides, 2–5 mm. broad, soft, light green; leaves many, slightly shorter than culm;

blades linear, 2–6 mm. broad, folded, light green, soft, gradually tapering to an acute apex; sheaths rather long, pale or yellowish brown; corymbs simple or in part compound, occasionally the inflorescence becoming congested into a globose cluster of spikelets, 2–6 cm. long and broad; rays 3–9, very unequal in length, 1–4 cm. long; glomerules of spikelets 5–15 mm. across, densely bearing numerous spikelets, dark green or brownish green; leafy bracts 2 or 3, up to twice as long as corymb; spikelets lanceolate to linear-lanceolate, 2–8 mm. long, about 1 mm. broad, 8–28-flowered; rhachilla not winged; glumes laxly disposed, nearly orbicular, rounded at apex, membranous, 0.5–0.8 mm. long and broad, faintly 3-nerved, deep green and tinged with brown-purple on both sides, yellowish on keel; achenes ovate-elliptic, 3-sided, nearly equalling the glumes, yellowish at maturity; style about half as long as achene; stigmas 3; stamens 2 or 1.

TIPIFICATION: Linnaeus's original comment is merely: "Hab. in India."

DISTRIBUTION: Widespread in Eurasia from southern Europe through India and China to Japan and Malesia, and also in Australia and the Pacific Islands; introduced into Central America and southern Africa. In Fiji the species is a naturalized adventive, occurring near sea level in wet places in the open, in swamps and pastures, along roadsides, and often abundantly in rice fields. It is more common than the available 17 collections indicate. The first occurrence noted in Fiji may have been *Greenwood* 479 (August, 1922). The plant flowers and fruits throughout the year, often growing together with *Cyperus iria*.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Vicinity of Nandi, *DA*, July 6, 1954. NADRONGA & NAVOSA: Singatoka Experiment Station, *DA* 94. SERUA: Tokotoko road, Navua (and into adjacent Namosi Province), *DA* 10557. RA: Yanggara, *DA* 11873. NAITASIRI: Waindina River, *DA* 3831; Nasinu, *DA* 7527. TAILEVU: Verata, *DA* 5663; Wainimbokasi, *DA* 10573. VANUA LEVU: MATHUATA: Lambasa, *Greenwood* 479. THAKAUNDROVE: Wainigata Station, Savusavu, *DA* 12045; Maravu, near Salt Lake, *Degener & Ordenez* 14223. RAMBI: *DA* 5763.

9. *Cyperus haspan* L. Sp. Pl. 45. 1753; Kükenth. in Pflanzenr. **101** (IV. 20): 247. fig. 28, E–G. 1936; Greenwood in J. Arnold Arb. **25**: 397. 1944, in op. cit. **30**: 82. 1949; J. W. Parham in Dept. Agr. Fiji Bull. **35**: 152. 1959; T. Koyama in Micro-nesia **1**: 95. 1964; J. W. Parham, Pl. Fiji Isl. 297. 1964, ed. 2. 391. 1972; Kern in Fl. Males. **1**: 7: 624, as *C. halpan*. fig. 56, 57. 1974.

Perennial, with red-purple fibrous roots; rhizomes slender, horizontal, short or elongated; culms solitary and arranged in a row along an elongated rhizome or tufted with a short rhizome, erect, mostly 10–50 cm. tall, slender, trigonous, rather soft; leaves as a rule reduced to bladeless sheaths at base of culms; sheaths 2–10 cm. long, pale green and usually tinged with brown, purple-brown, or red-purple; blades occasionally developing especially in relatively dry habitats, but short; corymbs compound or simple, lax, 8–15 cm. long and broad; rays several, unequal, the longer ones 5–10 cm. long, slender, the raylets, if developing, few, up to 2 cm. long; leafy bracts 1 or 2, the longer one equalling to slightly shorter than corymb; spikelets digitately disposed at apices of rays or raylets, 4–6 together, linear-oblong, obtuse-tipped, flattened, 5–15 mm. long, 1–1.5 mm. broad, subdensely 10–28-flowered, the wingless rhachilla completely hidden by densely disposed glumes; glumes elliptic to lance-elliptic, ovate, about 1.5 mm. long, membranous, pale brownish and often tinged or variegated with rusty-brown or purple-brown, slenderly 3-nerved, the greenish keel ending in a short mucro; achenes obovate, 3-sided, about 0.5 mm. long, cream-yellow, tuberculate; style 1.5 times as long as achene; stigmas 3; stamens 3–1.

TIPIFICATION AND NOMENCLATURE: The material from Ceylon cited in Fl. Zeyl. (1747) is probably to be taken as the type. Kern (1974, cited above) uses the spelling *halpan*, indicating that Linnaeus misread the vernacular name as *haspan* and that

the correction should now be made. As the spelling *haspan* has been consistently used in many works, I prefer to continue it, believing that the change is not absolutely mandated by Article 73 (ICBN).

DISTRIBUTION: Tropical and subtropical regions of both hemispheres, the range in eastern Asia extending northward to Japan. In Fiji it occurs from near sea level to 160 m. as a naturalized adventive, in wet open places, swamps, pastures, creek banks, and rice fields. Flowers and fruits are seen throughout the year. It is more abundant than suggested by the approximately 20 available collections. It was established in Fiji at least by 1932, collected by Meebold and cited by Kükenthal.

REPRESENTATIVE COLLECTIONS: VITI LEVU: SERUA: Vicinity of Ngaloa, *Smith 9627*; Ndeumba, west of Navua, *DA 9180 (McKee 2744)*. NAITASIRI: Adi Cakobau School, Sawani, *DA 7623*; Mbatiki, *DA 7407*; near Nasinu, *Greenwood 1134*. TAILEVU: Mbau road, near Kuku, *DA 10612*. REWA: Vicinity of Suva, *Meebold 17104*. VANUA LEVU: MBUA: Vicinity of Mbua, *DA 5021*. MATHUATA: Vunitivi, Lambasa, *DA 10461*. THAKAUNDROVE: Eastern drainage of Yanawai River, *Degener & Ordóñez 14105*.

10. *MARISCUS* Vahl, Enum. Pl. 2: 372. 1805 or 1806; Seem. Fl. Vit. 319, p. p. 1868. Nom. cons.

Cyperus sensu Seem. Fl. Vit. 319, p. p. 1868; non L.

Vegetative characters as in *Cyperus*; spikelets with few to many glumes distichously disposed on a continuous rhachilla, subterete, subtetragonous, or laterally flattened; rhachilla jointed at base above prophyll, hence spikelets falling entire apart from rhachis and prophyll; glumes nearly all alike, often only 1-several fruit-bearing; flowers bisexual, with 1-3 stamens; perianth bristles none; achenes trigonous, linear-oblong, or elliptic; style not jointed at base, 3-fid at apex forming 3 stigmas.

TYPE SPECIES: *Mariscus capillaris* (Sw.) Vahl (*Schoenus capillaris* Sw.). Typ. cons. (ICBN).

DISTRIBUTION: About 200 species in the temperate, subtropical, and tropical regions of both hemispheres, with high species concentration in the American tropics.

KEY TO SPECIES

Spikelets weakly to moderately flattened, with acute angles; fruits (2-) 3-many to a spikelet; glumes brown or straw-brown, folded.

Corymbs decompound or compound; spikelets 5-7 mm. long, 6-8-flowered. 1. *M. javanicus*

Corymbs simple or in part compound; spikelets 3-4 mm. long, (2- or) 3-flowered. 2. *M. seemannianus*

Spikelets terete, without acute edges; fruits as a rule 1 to a spikelet; glumes green or yellowish, involute.

Spikelets divergent to slightly reflexed, the spikes hardly narrowed toward base, mostly on elongated rays. 3. *M. sumatrensis*

Spikelets erect-patent, especially the lower ones nearly erect, hence the spikes narrowed toward base, the rays very short or the spikes subsessile. 4. *M. cyperinus*

1. *Mariscus javanicus* (Houtt.) Merr. & Metcalfe in Lingnan Sci. J. 21: 4. 1945.

Cyperus javanicus Houtt. Nat. Hist. 13: 68. pl. 88, fig. 1. Aanwyz. Plaat. [1]. 1782; Merr. in J. Arnold Arb. 19: 321. 1938; Yuncker in Bishop Mus. Bull. 184: 26. 1945, in op. cit. 220: 69. 1959; J. W. Parham in Dept. Agr. Fiji Bull. 35: 152. 1959; T. Koyama in Micronesica 1: 98. 1964; J. W. Parham, Pl. Fiji Isl. 297. 1964, ed. 2. 391. 1972; Kern in Fl. Males. 1: 7: 635. fig. 63. 1974; non *C. javanicus* Kükenth. (1931) (= *C. kükenthalii* Merr., 1938).

Cyperus pennatus Lam. Tabl. Encycl. Méth. Bot. 1: 144. 1791; Seem. Fl. Vit. 319. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 330. 1892; Christophersen in Bishop Mus. Bull. 128: 16. 1935; Kükenth. in Pflanzenr. 101 (IV. 20): 476. fig. 53, A-G. 1936.

Cyperus sp. Seem. in Bonplandia 10: 297. 1862, Viti, 444. 1862.

Coarse perennial, tufted with short rhizome; culms robust, 40-110 cm. tall, 3-5 mm. thick, obtusely trigonous, minutely granulate, glaucous-green; leaves many, mostly surpassing culms; blades linear, 8-12 mm. broad, coriaceous, plicate below

middle, flattish to incurved-margined above middle, glaucous-green and often white-powdery, septate-nodulose, prominently scabrous on margins; sheaths dark brown or purple-brown, cylindric, septate-nodulose; corymbs compound to decompound, ample, 10–15 cm. long; primary rays 6–10, up to 12 cm. long, patent, sub-rigid; secondary corymbs with 3–6 raylets; spikes cylindric to oblong, 1.5–3 cm. long, 8–12 mm. broad, bearing many spikelets; leafy bracts 5 or 6, the lower ones much surpassing corymb; spikelets divergent to slightly reflexed, lanceolate to oblong-lanceolate, 4.5–6 mm. long, 1.8–2 mm. broad, turgid, 4–6-flowered, gray-brown and white-powdery; rhachilla rather broadly winged, jointed above prophyll; glumes broadly ovate, abruptly acuminate at apex, about 3 mm. long, subcoriaceous, brownish with rust-colored lineolae, the margins whitish-hyaline, many-nerved; keel hardly ridged, forming an obtuse back; achenes oval to obovate, 3-sided, about half as long as the glume, black-brown at maturity, minutely punctulate; style elongated; stigmas 3; stamens 3.

TYPEIFICATION AND NOMENCLATURE: *Cyperus javanicus* is typified by material collected in Java by Thunberg, *C. pennatus* by a Commerson Javanese collection. The two concepts are not maintained as separate by recent authors.

DISTRIBUTION: From tropical Africa and Madagascar through India, southern China, and the southern Ryukyus to Micronesia, Malesia, northern Australia, and the Pacific Islands. In Fiji it occurs near sea level on sandy shores or rocky coasts, in brackish swamps behind mangroves, in open places, ditches, and on plantations. It is in flower and fruit throughout the year and is probably more abundant than suggested by the 17 available collections.

LOCAL NAMES: *Ndavairanduna*; *malava ni kau ni mata*.



FIGURE 63. *Mariscus seemannianus*, from Degener & Ordonez 14150; A, inflorescence with leafy bracts, $\times 1$; B, distal portion of a spike, $\times 10$.

REPRESENTATIVE COLLECTIONS: MAMANUTHAS: Malolo Group, NGGALITO Island, *O. & I. Degener* 32256. VIII LEVU: MBA: Lautoka, *Greenwood* 280. SERUA: Vicinity of Ngaloa, *Degener* 15114. RA: Ellington, *DA* 7893. TAILEVU: Navuloa, *DA* 9327. VITI LEVU without further locality, *Milne* 420. OVALAU: *Graeffe* 1234; Lando islets off south coast, *Storck* 912. NGAU: Shore of Herald Bay, near Sawaieke, *Smith* 7999. VANUA LEVU: THAKAUNDROVE: Savusavu Bay region, *Degener & Ordóñez* 13882. MOALA: North coast, *Smith* 1395. KANATHEA: *DA* L.14753. LAKEMBA: Near Yandrana Village, *Garnock-Jones* 949. FULANGA: On limestone formation, *Smith* 1165.

2. *Mariscus seemannianus* (Boeck.) Palla in Denkschr. Akad. Wiss. Wien **84**: 452. 1909. FIGURE 63.

Mariscus laevigatus sensu Hook. & Arn. Bot. Beechey Voy. 72. 1832; Seem. in Bonplandia **9**: 261. 1861, Viti, 444. 1862; Greenwood in Proc. Linn. Soc. **154**: 105. 1943; J. W. Parham in Dept. Agr. Fiji Bull. **35**: 154. 1959; non Roemer & Schultes.

Mariscus flavus sensu Seem. Fl. Vit. 319. 1868; non Vahl.

Cyperus seemannianus Boeck. in Linnaea **36**: 390. 1870; Christophersen in Bishop Mus. Bull. **128**: 16. 1935; Kükenth. in Pflanzenr. **101** (IV. 20): 482. 1936; J. W. Parham, Pl. Fiji Isl. 297. 1964, ed. 2. 392. 1972.

Cyperus monostachys Boeck. in Linnaea **36**: 389. 1870.

Cyperus flavus sensu Drake, Ill. Fl. Ins. Mar. Pac. 329, quoad spec. vit. 1892; non Boeck.

Cyperus seemannianus var. *monostachys* Kükenth. in Christophersen in Bishop Mus. Bull. **128**: 18. 1935, in Pflanzenr. **101** (IV. 20): 483. 1936.

Culms loosely tufted, with short cormlike rhizome, 30–45 cm. tall, leaved at base; leaves linear, mostly surpassing culm, 4–5 mm. broad, flattish-plicate, the sheaths brownish purple; corymbs simple or in part compound with 2–7 rays 1–5 cm. long; leafy bracts 5–8, much longer than corymb; spikes 4–7 to a corymb, radiate, cylindric, 2–3 cm. long, 6–8 mm. broad; spikelets divaricate, lance-oblong, 3–4 mm. long, about 1.5 mm. broad, weakly flattened, with acute edges, 2- or 3-flowered; glumes broadly ovate, subcoriaceous, obtuse, straw-colored, 7- or 9-veined; achenes about 2/3 as long as the subtending glume, 3-sided; stamens 3.

TIPIFICATION AND NOMENCLATURE: Boeckeler's two names, *Cyperus seemannianus* and *C. monostachys*, were proposed simultaneously, but Palla used the first of these in the genus *Mariscus*. *Cyperus seemannianus* is typified by *Seemann* 669, from Fiji. Boeckeler did not designate a further locality, but the specimen (κ HOLOTYPE) is indicated as from "Namara." This refers to a part of the Viti Levu mainland north of Viwa Island, now part of Mbau Tikina in Tailevu Province. Seemann visited the area sometime between July 24 and August 2, 1860, while he was staying on Mbau Island (cf. Viti, 121–134. 1862). For *C. monostachys* Boeckeler cited a Seemann specimen from Fiji without other locality. However, there is no Seemann specimen at κ so annotated by Boeckeler, and in the κ copy of the original publication "Seemann" has been crossed out and "Milne" added. This is doubtless correct, as one of the three Milne specimens of this taxon at κ bears the inscription: "*Cyperus monostachys* Boeck. Linnaea XXXVI. 389." The holotype of *C. monostachys*, therefore, may be taken as *Milne* 170 (κ), collected on Ngau in 1855. Kükenth. believed *C. monostachys* to be worthy of varietal status, but in my opinion there are no significant differences between the two taxa of this alliance that Boeckeler based on Fijian types.

DISTRIBUTION: Fiji, Tonga, Samoa, and the Society Islands. In Fiji the species occurs near sea level on swampy ground and wet rocky slopes, and sometimes in coconut plantations. It is not abundant and has been infrequently collected, although Seemann indicated it as common.

LOCAL NAME: *Tumbe ni wangga*.

AVAILABLE COLLECTIONS: VITI LEVU: NANDRONGA & NAVOSA: Thuvu, west of Singatoka, *Greenwood* 281. NAIRAI: *Milne* 166. VANUA LEVU: MATHUATA: Lambasa, *Greenwood* 496, 497. THAKAUNDROVE: Savusavu, *DA* 8861; Maravu, near Salt Lake, *Degener & Ordenez* 14150. MOALA: *Milne* s. n. FIJI without further locality, *U.S. Expl. Exped.*, *DA* 3426, 3901.

3. *Mariscus sumatrensis* (Retz.) T. Koyama in Gard. Bull. Singapore 30: 154. 1977.

Scirpus cyperoides L. Mant. Pl. Alt. 181. 1771.

Kyllinga sumatrensis Retz. Obs. Bot. 4: 13. 1786.

Mariscus sieberianus Nees in Linnaea 9: 286, nom. nud. 1835; Nees ex C. B. Clarke in Hook. f. Fl. Brit. Ind. 6: 622. 1893; J. W. Parham in Dept. Agr. Fiji Bull. 35: 154. 1959.

Cyperus cyperoides Kuntze, Rev. Gen. Pl. 3 (2): 333, as *C. cyperodes*. 1898; Christophersen in Bishop Mus. Bull. 128: 15. 1935; Kükenth. in Pflanzenr. 101 (IV. 20): 514. 1936; Yuncker in Bishop Mus. Bull. 178: 25. 1943, in op. cit. 184: 25. 1945, in op. cit. 220: 69. 1959; J. W. Parham in Dept. Agr. Fiji Bull. 35: 153. 1959; T. Koyama in Micronesica 1: 97. 1964; J. W. Parham, Pl. Fiji Isl. 296. 1964, ed. 2. 391. 1972; Kern in Fl. Males. 1: 7: 642. 1974.

Mariscus cyperoides Urb. Symb. Antill. 2: 164. 1900; Greenwood in Proc. Linn. Soc. 154: 105. 1943; J. W. Parham in Dept. Agr. Fiji Bull. 35: 154. 1959; non Dietr. (1833).

Perennial, with short woody rhizome clothed with brown fibers; culms solitary or few together, erect, triquetrous, 10–50 cm. tall, smooth, the more or less thickened base leafy; leaves many, shorter than to equalling culm; blades linear, 3–6 mm. broad, flattish-plicate, herbaceous; sheaths pale, eventually becoming brownish or reddish brown; corymbs simple, open, 3–8 cm. broad; rays 3–12, patent, the longer ones up to 8 cm. long, terminated by a spike; spikes cylindric, 1–2.5 cm. long, 6–10 mm. broad, densely bearing many spikelets, greenish; leafy bracts 3–8, the lower ones surpassing the corymb; spikelets spreading or the lower ones more or less reflexed, linear-lanceolate, 3–5 mm. long, about 0.7 mm. broad, bearing 4 or 5 glumes, 1- or 2-fruited; rhachilla jointed above base, with white-hyaline lanceolate wings; glumes lance-oblong, obtuse or mucronulate at apex, about 3 mm. long, with inrolled margins, membranous, pale green, several-nerved, the keel 3-nerved, forming an obtuse back; achenes linear-oblong, about 2/3 as long as glume, straw-colored, minutely punctulate; style longer than achene; stigmas 3; stamens 3.

TIPIFICATION AND NOMENCLATURE: The earliest valid name of this taxon, *Scirpus cyperoides*, was sent from India (or possibly Ceylon) by König. However, the epithet cannot be used in *Mariscus* because of Dietrich's earlier homonym. The next valid name, not cited above, is *Kyllinga umbellata* Rottb. (Descr. Icon. Rar. Pl. 15. 1773), but this name is illegitimate because Rottbøll cited *Scirpus cyperoides* in its synonymy. Therefore *Kyllinga sumatrensis*, typified by material from Sumatra, provides the earliest basionym that can be used in *Mariscus*.

DISTRIBUTION: Tropical Africa, tropical and subtropical Asia, Malesia, and northern Australia; introduced into other areas, including the West Indies. In Fiji the species is a naturalized adventive, occurring infrequently between sea level and 900 m., on open grassy slopes and river banks, and in coconut plantations.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Lautoka, *Greenwood* 176, 176A; Nandarivatu, *Gillespie* 4178. RA: Ndombuilevu, *DA* 7300, 7310, 7312, 7313, 7852. TAVEUNI: Waitavala, *DA* 8899.

4. *Mariscus cyperinus* (Retz.) Vahl, Enum. Pl. 2: 377. 1805 or 1806.

Kyllinga cyperina Retz. Obs. Bot. 6: 21. 1791.

Cyperus cyperinus Suringar, Het. Gesl. Cyperus in Mal. Arch. 154. t. 6, fig. 10. 1898; Kükenth. in Pflanzenr. 101 (IV. 20): 518. 1936; Yuncker in Bishop Mus. Bull. 220: 68. 1959; T. Koyama in Micronesica 1: 97. 1964; J. W. Parham, Pl. Fiji Isl. ed. 2. 391. 1972; Kern in Fl. Males. 1: 7: 641. 1974.

Cyperus cyperoides subsp. *cyperinus* Kükenth. in Bot. Jahrb. 59: 46. 1924; Christophersen in Bishop Mus. Bull. 128: 16. 1935; Yuncker in op. cit. 184: 25. 1945.

Perennial, with short woody rhizome clothed with brown fibers; culms solitary or few together, erect, 20–70 cm. tall, triquetrous, smooth, leaved at the more or less thickened base; leaves several, shorter than culm; blades narrowly linear, 5–7 mm.

broad, herbaceous, flattish-plicate; sheaths pale green and stained with purplish pink; corymbs simple, open but with short rays, sometimes nearly headlike; rays 6–10, 0–5 cm. long, each terminated by a spike; spikes cylindric or oblong, narrowed toward base, 1.5–3 cm. long, 8–12 mm. broad, greenish, densely bearing many spikelets; leafy bracts 4–10, the lower few surpassing the corymb; spikelets patent to erect-patent, linear-lanceolate, subterete, 4–6.5 mm. long, about 1 mm. thick, bearing 4–7 glumes and 2 or 3 achenes; rhachilla with lanceolate wings, jointed above prophyll; glumes tightly erect, elliptic to oblong-elliptic, 3–3.5 mm. long, inrolled, membranous to thin-chartaceous, obtuse or abruptly acute at apex, glaucous-green and eventually tinged with straw-brown, 3- or 4-nerved on both sides, the green keel convex; achenes linear-oblong, trigonous, about 2/3 as long as glume, brownish, minutely granulate; style slightly longer than achene; stigmas 3; stamens 3.

TIPIFICATION AND NOMENCLATURE: For *Kyllinga cyperina* Retzius cites merely: "India Orientali." This taxon is sometimes combined with the preceding at a subspecific level, but the differences seem adequate to allow the recognition of two distinct species.

DISTRIBUTION: From India eastward to Malesia and northern Australia, and northward to China and Japan. It is widely naturalized in the Pacific; in Fiji it occurs near sea level on seashores, roadsides, and hillsides, and in open places, villages, and rice fields. Flowers and fruits have been noted throughout the year. Twenty Fijian collections are available.

REPRESENTATIVE COLLECTIONS: YASAWAS: WAYA: Yalombi Village, *St. John* 18171. VITI LEVU: RA: Yanggara, *DA* 10741; Ndombuilevu, *DA* 7826. NAITASIRE: Nawanggambena, *DA* 729. TAILEVU: Korovou, *DA* 1326; Matavatathou, *DA* 7773. REWA: Lomanikoro, *DA* 429. YANUTHA: *DA* 9034. OVALAU: *Milne* 281. VANUA LEVU: MATHUATA: Tambia, *DA* 8754. THAKAUNDROVE: Wainigata Station, near Savusavu, *DA* 12030. TAVEUNI: Likuvuasombia, *DA* 8912. FIJI without further locality, *Horne* 193.

Kükenthal (in *Pflanzenr.* **101** (IV, 20): 520, 1936) cited a Fijian collection made by Gehrmann as *Cyperus cyperinus* var. *maximus* (C.B. Clarke) Kükenth., but the variety would appear to be merely a vigorous phase not worth nomenclatural recognition.

11. TORULINIUM Desv. ex Hamilton, Prodr. Pl. Ind. Occ. 15. 1825.

Mariscus sensu Seem. Fl. Vit. 319, p. p. 1868; non Vahl.

Cyperus sensu Seem. Fl. Vit. 319, p. p. 1868; non L.

Annuals or perennials, with culms leaved only at base; inflorescence an umbelliform corymb, subtended by few leafy bracts; spikelets with several to many 2-ranked glumes; rhachilla articulated between flowers and breaking into segments containing 1 achene, usually winged, the wings eventually becoming more or less corky and clasping achene; achenes 3-sided; stigmas 3.

TYPE SPECIES: *Torulinium ferax* (L.C. Rich.) Hamilton (= *T. odoratum* (L.) S. Hooper).

DISTRIBUTION: About ten species in the tropics of both hemispheres, with high species concentration in tropical America. A single species occurs in Fiji.

1. *Torulinium odoratum* (L.) S. Hooper in Kew Bull. **26**: 579. 1972.

Cyperus odoratus L. Sp. Pl. 46. 1753; J. W. Parham, Pl. Fiji Isl. 297. 1964, ed. 2. 391. 1972; Kern in Fl. Males. **1**: 7: 645. 1974.

Cyperus ferax L. C. Rich. in Acta Soc. Hist. Nat. Paris **1**: 106. 1792; Kükenthal in *Pflanzenr.* **101** (IV, 20): 615. fig. 6, K-P. 1936.

Cyperus sp. Seem. in Bonplandia **9**: 261. 1861, Viti, 444. 1862.

Mariscus phleoides sensu Seem. Fl. Vit. 319. 1868; non Nees ex Steud.

Cyperus strigosus sensu Seem. Fl. Vit. 320. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 330. 1892; J. W. Parham in Dept. Agr. Fiji Bull. **35**: 152. 1959; non L.

Cyperus phleoides sensu Drake, Ill. Fl. Ins. Mar. Pac. 330, as *C. phloeoides*. 1892; J. W. Parham, Pl. Fiji Isl. 297. 1964, ed. 2. 392. 1972; non Hillebr.

Mariscus ferax C. B. Clarke in Hook. f. Fl. Brit. Ind. 6: 624. 1893; J. W. Parham in Dept. Agr. Fiji Bull. 35: 154. 1959.

Annual, or short-lived perennial under certain conditions; culms solitary or few together, erect, 30–100 cm. tall, triquetrous, smooth, with a bulbous enlargement at base; leaves several, shorter than culm; blades linear, 4–10 mm. broad, flattish, herbaceous; sheaths rather long, brownish or purplish brown; corymbs ample, compound to decompound, loose to subdense, 5–30 cm. broad; rays 5–12, patent, the longer ones up to 20 cm. long; raylets several to each secondary corymb, 0–3 cm. long; spikes oblong-cylindric, 2–3 cm. long, about 1.5 cm. broad, bearing 20–40 spikelets; leafy bracts 6–8, patent, the lower ones surpassing the corymb, the lowest up to 50 cm. long; spikelets spreading to reflexed, linear, subterete, 10–25 mm. long, 1–1.5 mm. broad, 10–25-flowered, yellow-green and yellowish brown at maturity; rhachilla flexuous, winged, the wings elliptic, first hyaline and eventually becoming more or less corky and tightly clasping nut; glumes ovate-elliptic, obtuse, 2–3.5 mm. long, yellowish and red-brown-striate, the greenish obtuse costa 7–9-nerved; achenes oblong to oblong-obovate, 3-sided, 2/3 as long as glume, falling off tightly enveloped with rhachilla-wings together with rhachilla-internode and the next higher glume; style shorter than achene; stigmas 3; stamens 3.

LECTOTYPIFICATION AND NOMENCLATURE: Of the three references cited by Linnaeus, the Sloane collection from Jamaica is best considered the lectotype of *Cyperus odoratus*. *Cyperus ferax* is typified by a Leblond collection from Cayenne. The other references listed above are based on misidentifications, *Mariscus phleoides* Nees ex Steud. being endemic to Hawaii.

DISTRIBUTION: Pantropical. In Fiji the species occurs from near sea level to 100 m. and is often common in swamps, although the number of available collections is limited.

LOCAL NAME: *Malanga*.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Hills near Lautoka, *Greenwood 299*. NANDRONGA & NAVOSA: Near Tonuve Village, *H. B. R. Parham 190*, p. p. NAITASIRI: Viria, *Meebold 17005*; Nanduna, *DA 774*. TAILEVU: Namara (in present Mbau Tikina), *Seemann 668*, July, 1860. VANUA LEVU: THAKAUNDROVE: Wainigata Station, near Savusavu, *DA 12044*. FIJI without further locality, *Horne 334*, *DA 3714*, *3715*, s. n.

12. PYCREUS Beauv. Fl. Oware 2: 48. 1816.

Vegetative characters as in *Cyperus*; spikelets with few to many glumes 2-ranked on a continuous simple axis, laterally flattened; glumes all alike, bearing a bisexual flower at axil; flowers with a digynous pistil and 1–3 stamens; hypogynous bristles none; achenes laterally flattened, lenticular, with one of the angles facing rhachilla, the sides punctulate or undulate; style not jointed at base; stigmas 2.

TYPE SPECIES: *Pycreus polystachyos* (Rottb.) Beauv.

DISTRIBUTION: About 70 species in the temperate, subtropical, and tropical regions of the world, with a high species concentration in Africa. Only one species occurs in Fiji.

1. *Pycreus polystachyos* (Rottb.) Beauv. Fl. Oware 2: 48. pl. 86, fig. 2. 1816.

Cyperus polystachyos Rottb. Descr. Icon. Rar. Pl. 39. t. 11, fig. 1. 1773; Christophersen in Bishop Mus. Bull. 128: 16. 1935; Kükenth. in Pflanzenr. 101 (IV. 20): 367. 1936; J. W. Parham in Dept. Agr. Fiji Bull. 35: 152. 1959; Yuncker in Bishop Mus. Bull. 220: 70. 1959; T. Koyama in Micronesica 1: 96. 1964; J. W. Parham, Pl. Fiji Isl. 297. 1964, ed. 2. 392. 1972; Kern in Fl. Males. I. 7: 649. 1974.

Pycreus polystachyus Beauv. ex Greenwood in Proc. Linn. Soc. 154: 105. 1943; J. W. Parham in Dept. Agr. Fiji Bull. 35: 154. 1959.

Presumably annual; culms tufted, stiffly erect, (16-) 20-150 cm. tall, triquetrous, smooth; leaves few, shorter than culms; blades linear, 1.5-3 mm. broad, stiff, flat-tish-plicate; sheaths reddish brown; corymbs often contracted in a subglobose or irregularly lobed headlike cluster of spikelets without rays, 2-5 cm. across, sometimes more or less open with 2-5 short rays up to 5 cm. long; leafy bracts 3-5, usually the lowest only surpassing inflorescence; spikelets digitately disposed, linear to linear-lanceolate, 1-2.5 cm. long, 1.5-2 mm. broad, acute at apex, flattened, 10-40-flowered, yellowish red-brown; rhachilla flexuous; glumes oblong-ovate to ovate, 1.5-1.8 mm. long, acute at apex, thin-chartaceous, straw-colored or reddish brown, narrowly white-membranous on margins, nerveless except for 3-nerved greenish keel; achenes oblong-obovate, about 1 mm. long, lenticular, dark brown at maturity, minutely punctulate; style about twice as long as achene; stigmas 2; stamen 1.

TYPEFICTION: *Cyperus polystachyos* was based on Plukenet's *t. 416, fig. 6*, which may be taken as the holotype.

DISTRIBUTION: Pantropical and subtropical. In Fiji it is an abundantly naturalized adventive, some 90 collections being available, occurring from near sea level to the highest elevation of the group, 1,323 m. It is found in wet places such as seashores, river banks, edges of ponds, and pastures, and it also is a weed in villages, plantations, cane fields, and on cleared ridges. Flowers and fruits are seen throughout the year.

LOCAL NAME: *Thonindawai* (noted only in interior Naitasiri Province).

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Nandi airport, *DA 8255*; Lautoka, *Greenwood 29*; northern portion of Mt. Evans Range, *Smith 4340*; Tavua, *DA 8171*; summit of Mt. Tomanivi, *DA 7089*. NANDRONGA & NAVOSA: Nggalimare, Singatoka Valley, *H. B. R. Parham 332*. SERUA: Vicinity of Ngaloa, *Smith 9501*; Navua, *DA 10556*. NAMOSE: Hills near Wainavindrau Creek, vicinity of Wainimakutu, *Smith 8572*; Namuamua, *Parks 20167*. RA: Yanggara, *DA 11869*; Rakiraki, *DA 7929*. NAITASIRI: Matawailevu, upper Wainimala Valley, *St. John 18198*; Vunindawa, *DA 7790*; vicinity of Nasinu, *Gillespie 3410*. TAI-LEVU: Hills east of Wainimbuka River, near Ndakuivuna, *Smith 7092*; Wainimbokasi, *DA 861*. REWA: Mt. Korombamba, *DA 1242*; vicinity of Suva, *Meebold 17106*. VANUA LEVU: MBUA: Mbua, *DA 5019*; Ndama River, *DA 1583*. MATHUATA: Seanggangga Plateau, vicinity of Natua, *Smith 6699*; Lambasa, *Greenwood 29A*. THAKAUNDROVE: Maravu, near Salt Lake, *Degen & Ordonez 14220*. TAVEUNI: Wai-tavala, *DA 8891*. KANATHEA: *DA L.14755*. VANUA MBALAVU: Lomaloma, *DA 10243*.

In spite of the abundance of this species in Fiji, it seems to be a comparatively recent arrival, the earliest available collection being *Greenwood 29*, made in February, 1919.

13. KYLLINGA Rottb. Descr. Icon. Rar. Pl. 12. 1773; Seem. Fl. Vit. 318. 1868. Nom. cons.

Perennials, with short or horizontally creeping rhizomes; culms leaved at base, inflorescence a head with 1-3 sessile spikes densely bearing many spikelets, subtended by few to several leafy bracts; spikelets bilaterally flattened with several glumes and usually 1- or 2-fruited, the rhachilla short, disarticulating at base above prophyll; glumes membranous to hyaline, strongly folded, the lowest 2 smaller than the others and empty, the middle glumes largest and flower-bearing, the distal glume empty or staminate; flowers bisexual and staminate, without perianth bristles; stamens 2 or 3; achenes laterally flattened, the style not jointed at base, 2-fid at apex, forming 2 stigmas.

TYPE SPECIES: *Kyllinga monocephala* Rottb., nom. illeg. p. p. (= *K. nemoralis* (J.R. & G. Forst.) Dandy ex Hutchinson & Dalziel). Typ. cons. (ICBN).

DISTRIBUTION: About 40 species in temperate, subtropical, and tropical regions of both hemispheres. Although the generic name is often misspelled as *Kyllingia*, in the present treatment it would be too cumbersome to record all such misspellings and so I shall always use the original spelling *Kyllinga*. Four species are known to

occur in Fiji. A fifth species, *K. odorata* Vahl (non *Cyperus odoratus* L.), often known as *K. sesquiflora* (Torr.) Mattf. & Kükenth., has been listed by J. W. Parham (in Dept. Agr. Fiji Bull. 35: 154. 1959, Pl. Fiji Isl. 298. 1964, ed. 2. 392. 1972). This record was supposedly based on a Greenwood collection, but I fail to find any supporting material, and the species was never listed in any of Greenwood's accounts of the Fijian adventive and weed flora.

KEY TO SPECIES

Glumes not winged; heads greenish.

Culms 30–50 cm. or more tall, close together on the horizontally decumbent or stoloniferous rhizome.

Leafy bracts 2 or 3. 1. *K. melanosperma*

Leafy bracts 5–8. 2. *K. polyphylla*

Culms mostly 7–30 cm. tall, spaced on the rhizome. 3. *K. brevifolia*

Glumes winged; heads whitish. 4. *K. nemoralis*

1. *Kyllinga melanosperma* Nees in Wight, Contr. Bot. India, 91. 1834.

Cyperus melanospermus Suringar, Het. Gesl. Cyperus in Mal. Arch. 50. t. 2, fig. 8. 1898; Kükenth. in Pflanzenr. 101 (IV. 20): 583. 1936; J. W. Parham, Pl. Fiji Isl. ed. 2. 391. 1972; Kern in Fl. Males. 1. 7: 655. 1974.

Rhizome horizontal, lignescent, covered with dark brown scales; culms close together, arranged in a row along the rhizome, 30–100 cm. tall, 2.5–4 mm. thick, clothed at base with purple-brown sheaths; leaves mostly reduced to bladeless sheaths 2–5 cm. long, the uppermost 1 or 2 sometimes developing a short blade about 3 mm. broad; inflorescence a single terminal greenish spike, ovoid to subglobose, 6–12 mm. long, 6–8 mm. across; leafy bracts usually 3, patent; spikelets many, densely disposed, narrowly elliptic, about 3 mm. long, 1- or 2-flowered; glumes lance-ovate, pale straw-colored, often tinged with brown, 3-nerved, often spinulose on the acute keel, mucronate at apex; stamens 3; achene 1/2–1/3 as long as the subtending glume, oblong, lenticular, maturing blackish; style long, 2-fid at apex.

TIPIFICATION: Based on a collection from India by Rottler.

DISTRIBUTION: Tropical Africa, southern and southeastern Asia, and eastward to Melanesia. In Fiji it is a naturalized adventive occurring sparingly in southern Viti Levu from near sea level to 460 m., in open swampy places along forest streams, on river banks, in forest clearings, and occasionally along roadsides; it is less abundant and less aggressive than the following species.

LOCAL NAME: *Tanivori*.

AVAILABLE COLLECTIONS: VITI LEVU: SERUA: Vatutavathe, vicinity of Ngaloa, *Degener 15181*; Ndeumba, west of Navua, *DA 8640, 9197 (McKee 2760)*. NAMOSE: Hills bordering Wainavindrau Creek, vicinity of Wainimakutu, *Smith 8570*; Navunikambi, *DA 1401*; river bank above Nairaiyawa, *DA 1445*.

2. *Kyllinga polyphylla* Willd. ex Kunth, Enum. Pl. 2: 134. 1837.

Kyllinga aromatica Ridley in Trans. Linn. Soc. Bot. 2: 146. 1884.

Cyperus aromaticus Mattf. & Kükenth. in Pflanzenr. 101 (IV. 20): 581. 1936; J. W. Parham, Pl. Fiji Isl. 296. 1964, ed. 2. 390. 1972; Mune & Parham in Dept. Agr. Fiji Bull. 48: 64, fig. 18. 1967; Kern in Fl. Males. 1. 7: 656. 1974.

Kyllinga monocephala sensu J. W. Parham in Agr. J. Dept. Agr. Fiji 27: 94, fig. 16. 1956; Mune & Parham in Dept. Agr. Fiji Bull. 31: 70, fig. 16. 1957; J. W. Parham in op. cit. 35: 154. 1959; non Rottb. nec auct.

Cyperus melanospermus sensu J. W. Parham in Agr. J. Dept. Agr. Fiji 29: 23. 1959, in Dept. Agr. Fiji Bull. 35: 151, fig. 76, 77. 1959; non Suringar.

Rhizome knotty, creeping, lignescent, covered with dark purple scales; culms close together and arranged in 1 row along the rhizome, 30–35 cm. tall, acutely 3-angular, smooth, clothed at base with purplish bladeless sheaths; leaves 2–4, up to 4 mm. broad, much shorter than culm; head with 1–3 confluent spikes, 6–10 mm.

across, pale green, subtended by 5–8 long leafy bracts; spikelets narrowly elliptic, 3–3.5 mm. long, 1- or 2-flowered; glumes lance-ovate, pale to brownish yellow, the flower-bearing ones 3- or 4-nerved, the greenish spinulose keel ending in a recurved mucro; achenes obovate-oblong, about 2.5 as long as the fertile glume; style elongated, 2-fid; stamens 3.

TYPIIFICATION AND NOMENCLATURE: The type material of *Kyllinga polyphylla* came from Africa (Congo and Guinea) and Mauritius. For *K. aromatica*, Ridley cited two collections from West Africa in the Welwitsch herbarium.

DISTRIBUTION: Tropical Africa, Madagascar, and Mauritius; introduced elsewhere, including Ceylon, Singapore, the Solomon Islands, Fiji, and Samoa. In Fiji it is a vigorous and noxious weed, occurring near sea level along roadsides, on hill-sides and river banks, and in pastures, open swamps, and rice fields. It flowers and fruits throughout the year. About 30 collections are available.

LOCAL NAME: *Navua sedge*.

REPRESENTATIVE COLLECTIONS: VITI LEVU: SERUA: Ndeumba, west of Navua, *DA 8633*; Nakaulevu, Navua, *DA 10099*; lower Navua River, *Greenwood 984*; Tokotoko road, Navua (and into adjacent Namosi Province), *DA 10544*; NAMOSI: Wairoro Creek, *DA 10902*; Wainandoi River, *DA 10808*. NAITASIRI: Nanduna, *DA 9611*; Prince's Road, *DA 10930*; Nasinu, *DA 8031*. TAILEVU: Korovou, *DA 10448*. REWA: Queen's Road 8 miles west of Suva, *DA 10093*. VANUA LEVU: MBUA: Mbua, *DA 5020*. TAVEUNI: Mt. Vernon Estate, *DA 11533*.

Mune & Parham (1957, 1967, cited above) include this species in their accounts of the declared noxious weeds of Fiji, giving suggestions for its control. Plants were first noticed in Fiji in 1933, but it is most serious as a pest in the pastoral lands near Navua, hence the local name.

3. *Kyllinga brevifolia* Rottb. Descr. Icon. Rar. Pl. 13, t. 4, fig. 3. 1773; Christopher-
sen in Bishop Mus. Bull. **128**: 15. 1935; Greenwood in Proc. Linn. Soc. **154**: 105.
1943; J. W. Parham in Agr. J. Dept. Agr. Fiji **19**: 103. 1948, in Dept. Agr. Fiji
Bull. **35**: 154. 1959.

Cyperus brevifolius Hassk. Cat. Pl. Hort. Bogor. 24. 1844; Kükenth. in Pflanzenr. **101** (IV, 20): 600. 1936; Yuncker in Bishop Mus. Bull. **184**: 25. 1945, in op. cit. **220**: 68. 1959; T. Koyama in Micronesica **1**: 99. 1964; J. W. Parham, Pl. Fiji Isl. 296, as *C. brevifolia*. 1964, ed. 2. 390. 1972; Kern in Fl. Males. I. 7: 656. fig. 70. 1974.

Kyllinga sp. Seem. in Bonplandia **9**: 261. 1861, Viti, 444. 1862.

Kyllinga monocephala sensu Seem. Fl. Vit. 318, p. p. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 331, p. p. 1892; non auct.

Perennial, with long, creeping, slender rhizomes; culms remotely or closely arranged in a single row along the rhizome, 7–30 cm. tall, soft, slender, few-leaved at base; leaves radical and subradical; blades shorter than or occasionally equalling culms, narrowly linear, 2–3 mm. broad, soft, herbaceous, scabrid on margins and on abaxial midvein; sheaths membranous, brownish or purplish brown, the lower ones almost bladeless; inflorescence a terminal single globose head (rarely consisting of 2 or 3 heads); involucre bracts 3, leaflike, very unequal in length; head globose or broadly ovoid-globose, 5–10 mm. long and broad, pale green and often becoming straw-colored at maturity, densely bearing numerous spikelets; spikelets lance-oblong, compressed, 3–3.5 mm. long, jointed at base, 4- or 5-squamose, 1-flowered; glumes ovate-elliptic, folded, with an acute keel, membranous, pale green, sometimes with resinous spots, 7-nerved including midvein, cuspidate at apex, the keel sparsely spinulose toward apex, projecting beyond glume apex into a straight or slightly recurved short cusp; achene about 1.5 mm. long, obovate, laterally lenticular, brownish, punctulate; style 2-cleft.

TYPIIFICATION: The original material was obtained by König, probably in India or Ceylon.

DISTRIBUTION: Pantropical, in Asia extending northward to the warm temperate regions of China and northern Honshu, Japan. In Fiji it is a naturalized adventive, often locally common, occurring from near sea level to 1,100 m. in wet open places, swampy pastures, and cane fields, on rocks along streams in dense forest, river banks, hillsides, and cleared mountain ridges, and along roadsides. Approximately thirty Fijian collections are available, and flowers and fruits are seen throughout the year.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Nandi, *DA 10891*; Lautoka, *Greenwood 35*; Mt. Evans Range, *Greenwood 134, 425*; Mt. Nanggaranambuluta, *DA 2431a*. SERUA: Vicinity of Ngaloa, *Smith 9628*; Tokotoko road, Navua (and into adjacent Namosi Province), *DA 10542*. RA: Ndombuilevu, *DA 7866*. NAITASIRI: Nanduruloulou, *DA 245*; near Nasinu, *Greenwood 1131*. TAILEVU: Hills east of Wainimbuka River, near Ndakuivuna, *Smith 7128*; Mbau road, near Kuku, *DA 10621*. VITI LEVU without further locality, *Milne 15*, *Graeffe s. n.* VANUA LEVU: MBUA: Rukuruku Bay, *W. L. Parham s. n.* TAVEUNI: *Seemann 671*.

A variety sometimes recognized within this taxon is *Cyperus brevifolius* var. *stelulatus* Suringar, but I believe this to be merely a depauperate form not worth maintaining. Among the above-cited collections it would contain *Greenwood 134* and *425*, *Graeffe s. n.*, *Milne 15*, and *Seemann 671*.

4. *Kyllinga nemoralis* (J. R. & G. Forst.) Dandy ex Hutchinson & Dalziel, Fl. W. Trop. Afr. 2: 486, 487. 1936.

Kyllinga monocephala Rottb. Descr. Icon. Rar. Pl. 13, nom. illeg. t. 4, fig. 4. 1773; Seem. Fl. Vit. 318, p. p. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 331, p. p. 1892; Rendle in J. Linn. Soc. Bot. 39: 179. 1909; J. W. Parham in Agr. J. Dept. Agr. Fiji 19: 103. 1948, in Dept. Agr. Fiji Bull. 35: 154. 1959; Yuncker in Bishop Mus. Bull. 220: 70. 1959.

Thryocephalon nemorale J. R. & G. Forst. Char. Gen. Pl. 65. t. 65. 1775, ed. 2. 130. t. 65. 1776.

Cyperus kyllingia Endl. Cat. Hort. Acad. Vindob. 1: 94. 1842; Kükenth. in Pflanzenr. 101 (IV. 20): 606. fig. 64, C. D. 1936; Yuncker in Bishop Mus. Bull. 178: 25. 1943, in op. cit. 184: 26. 1945; J. W. Parham in Dept. Agr. Fiji Bull. 35: 153. 1959; T. Koyama in Micronesica 1: 100. 1964; J. W. Parham, Pl. Fiji Isl. 297. 1964, ed. 2. 391. 1972; Kern in Fl. Males. 1. 7: 659. 1974.

Kyllinga intermedia sensu Seem. in Bonplandia 9: 261. 1861, Viti, 444. 1862; non R. Br.

Perennial, laxly tufted, with long-creeping rhizome; culms close together or spaced along rhizome, erect, 10–45 cm. tall, triquetrous, not thickened at base; leaves many, usually shorter than culm; blades linear, 2–5 mm. broad, rather soft, flattish; sheaths brown to purple-brown; inflorescence a single head, bearing a globose central spike and 2 or 3 small lateral spikes, 5–10 mm. long, 5–7 mm. across, densely bearing many spikelets, whitish, the central spike with 3 or 4 leafy bracts, these spreading to reflexed, the lowest up to 30 cm. long; spikelets ovate-elliptic to lance-ovate, 2.7–3.5 mm. long, about 1.5 mm. broad, 1-flowered; glumes usually 5, the lowest 2 smaller and narrow, 1–1.5 mm. long, the others 2.5–3.5 mm. long, boat-shaped, thin-membranous, whitish and eventually becoming straw-colored, variegated with rusty-brown, 3- or 4-nerved on each side, broadly winged on the acute green keel, the wing serrulate, the keel ending in a short usually recurved cusp; achenes oblong-obovate or suborbicular, biconvex, 1.25–1.5 mm. long, maturing brownish; stigmas 2; stamens 3.

TYPIFICATION and NOMENCLATURE: The oldest name for this species, *Kyllinga monocephala*, is typified by a plant collected by König, probably in India or Ceylon; however, this is an illegitimate name because an earlier name, *Schoenus coloratus* L., was cited in its synonymy. The oldest available name, *Thryocephalon nemorale*, is based on a specimen collected in the Society Islands by J. R. & G. Forster on Cook's second voyage (locality not indicated in original publication, but cf. Forst. f. Fl. Ins. Austr. Prodr. 7. 1786). *Cyperus kyllingia* was based by Endlicher on *Kyllinga monocephala*.

DISTRIBUTION: Pantropical, but relatively scarce in tropical America. In Fiji it is a naturalized adventive occurring from near sea level to 850 m. and often locally common; about 30 collections are available. It is found along beaches, roadsides, and trails, and in lawns, wet valleys, open fields, pastures, gardens, and coconut plantations. It flowers and fruits throughout the year.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Vicinity of Nandi, *DA 10891*; vicinity of Nandari-vatu, *Gillespie 4232*. SERUA: Ndeumba, west of Navua, *DA 8631*. RA: Ndombuilevu, *DA 7316*. NAITASIRE: Vinindawa, *DA 8405*; Nasinu, *DA 8060*. TAILEVU: Matuku, *DA 7741*; Namara, Mbau Tikina, *Seemann 670*. REWA: Suva, *St. John 18919*. KANDAVU: Ngaloa Island, *DA 9075*. VANUA LEVU: MATHUATA: Tambia, *DA 8756*; Lambasa, *Greenwood 35A*. THAKAUNDROVE: Nalembalemba, *DA 10787*; Savusavu, *DA 8863*. TAVEUNI: Vicinity of Waiyevo, *Smith 8122*; Waitavala, *DA 8906*. LAKEMBA: Near Tumbou, *Garnock-Jones 878*.

14. *MACHAERINA* Vahl, Enum. Pl. 2: 238. 1805 or 1806; T. Koyama in Bot. Mag. (Tokyo) 69: 61. 1956; Kern in Acta Bot. Neerl. 8: 263. 1959, in Fl. Males. I. 7: 690. 1974.

Rhizomatose perennial herbs, often with elongated stolons; culms nodose, tufted or close together in a row along rhizome, ancipitous or rarely terete; leaves basal and a few upper ones cauline, 2-ranked, bilaterally flattened, subterete or angled; inflorescences paniculate, with few to several partial panicles with often fasciated branches; spikelets ovoid, somewhat turbinate or lanceolate, with continuous rachilla, 1-several-flowered but often only the lowest flower achene-bearing; glumes 2-ranked, the lower 1-4 empty and smaller than the fruit-bearing one, the uppermost small, staminate or empty; flowers hermaphrodite or staminate, with or without hypogynous bristles; achenes ovate or elliptic, 3-sided to subterete, often stipitate at base, crowned by a style base; stigmas 3.

TYPE SPECIES: *Machaerina restioides* (Sw.) Vahl, the only original species, based on *Schoenus restioides* Sw.

DISTRIBUTION: About 45 species, mostly in Oceania, with a few in tropical Asia, Africa, and America. A single species is represented in Fiji. The generic name *Cladium* P. Br. has often been confused with *Machaerina*, a situation discussed in the papers listed below.

USEFUL TREATMENTS OF GENUS: Koyama, T. Taxonomic study of Cyperaceae V. Bot. Mag. (Tokyo) 69: 59-67. 1956. Kern, J. H. Florae Malesianae praecursores, XXII. *Cladium* and *Machaerina* (Cyper.). Acta Bot. Neerl. 8: 263-268. 1959.

1. *Machaerina falcata* (Nees) T. Koyama in Bot. Mag. (Tokyo) 69: 63. 1956; J. W. Parham, Pl. Fiji Isl. ed. 2. 394. 1972; Kern in Fl. Males. I. 7: 694. fig. 90. 1974.

Baumea falcata Nees in Hook. J. Bot. Kew Gard. Misc. 6: 29. 1854.

Baunia sp. Seem. in Bonplandia 9: 261. 1861, Viti, 444. 1862.

Cladium samoense C. B. Clarke ex Stapf in Trans. Linn. Soc. Bot. 4: 245, p. p., typ. excl. 1894.

Cladium samoense var. *uniseta* (sic) C. B. Clarke ex Stapf in Trans. Linn. Soc. Bot. 4: 246. 1894.

Cladium falcatum C. B. Clarke in Kew Bull. Add. Ser. 8: 46. 1908.

Perennial herb, tufted with short rhizome; stem ancipitous, smooth, 50-100 cm. tall, 3-6 mm. broad, several-leaved at base and usually 1-leaved in the middle part; leaves equitant, ensiform, coriaceous, shorter than culm, 1-2 cm. broad, gradually narrowed to an acute apex, glaucous-green; inflorescence an erect panicle, ovate to oblong in outline, 10-20 cm. long, dense, bearing 3 fascicles rather contiguously; bracts of partial fascicles short-bladed, the sheath brown, ancipitous; peduncles hardly exerted from the subtending bract; spikelets subterebinate at maturity, 6-7 mm. long, 2.5-3 mm. broad, 2-4-flowered; glumes 5-7 to a spikelet, ovate-lanceolate, 5-6 mm. long, chartaceous, dark purple, obtuse to mucronate at apex; achenes ovoid, triquetrous with convex sides and winglike angles, 3-4 mm. long, about 1 mm. broad, rusty-brown, the base with a pyramidal stipe about 1.5 mm. long; style base

narrowly pyramidal, glabrous, persistent, about 1.5 mm. long; stigmas 3; hypogynous bristles usually absent; stamens 3.

TYPIIFICATION AND NOMENCLATURE: *Baumea falcata* is typified by *Cuming* 932, from the Philippine Islands. *Cladium samoense* in its original sense consisted of three different species: (1) *Cladium samoense* (= *Machaerina samoensis*), from Samoa, (2) *Machaerina aspericaulis*, from Borneo, and (3) *M. falcata*. *Machaerina samoensis* differs from *M. falcata* in details of floral parts, including the well-developed hypogynous bristles. Kükenthal (in Christophersen in Bishop Mus. Bull. 128: 21. 1935) pointed out this mixture, although using different names than those above. *Machaerina samoensis* in the typical sense has thus far not been found in Fiji. *Cladium samoense* var. *uniseta* was adequately described by Clarke, but no citation was included; the specimen bearing Clarke's label indicating that it was the basis for his trinomial is *Seemann* 665 (K HOLOTYPE), from Kandavu.

DISTRIBUTION: The Philippines and Malasia to Samoa. In Fiji it is not common, occurring at altitudes of 100–760 m. in the dense forest of crests and ridges, on open cliffs and ridges, and on the edges of forest. It has been collected in flower and fruit between January and June.

LOCAL NAME: *Misimisi*.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Mt. Evans Range, *Greenwood* 121. SERUA: Inland from Ngaloa, *DA* 16552. NAMOSI: Mt. Voma, *DA* 1969. NAITASIRE: Tholo-i-suva, *DA* 9826. REWA: Mt. Korombamba, *DA* 1177, 1235. OVALAU: Summit of Ndelaiovalau and adjacent ridge, *Smith* 7576. VANUA LEVU: MATHUATA: Wainikoro River area, *Greenwood* 689. FIJI without further locality, *Gillespie* 2720.

15. *Schoenus* L. Sp. Pl. 42. 1753; Kükenth. in Rept. Sp. Nov. 44: 15. 1938.

Perennials or rarely annuals; culms erect or with ascending base; leaves radical or a few upper ones cauline, with linear or setaceous leaves sheathing at base, the leaves rarely reduced to subaphyllous sheaths only; inflorescences paniculate or somewhat racemose, with several distant fascicles of spikelet-bearing branches, these subtended by leafy bracts, the whole inflorescence rarely congested into a headlike cluster; spikelets laterally flattened, mostly lanceolate to lance-oblong, sometimes more or less falcate, bearing several glumes on a flexuose rachilla, few-flowered; glumes caducous, usually chartaceous, brown to blackish purple with white margins, the few basal glumes empty and smaller than the upper flower-bearing ones; flowers hermaphrodite, but the uppermost usually not fruiting; hypogynous bristles 0–6; stamens as a rule 3; achenes obovoid to ellipsoid, 3-sided, rarely lenticular; style not jointed at base, hardly enlarged to base; stigmas 3, rarely 2.

LECTOTYPE SPECIES: *Schoenus nigricans* L. is usually considered to lectotypify the genus, among the nine species in Linnaeus's original treatment.

DISTRIBUTION: About 85 species, mostly in Oceania and southeastern Asia, but with a few species in Europe and America. Only one rare species is known to occur in Fiji.

1. *Schoenus achaetus* (T. Koyama) T. Koyama in Allertonia 1: 341. 1978.

Schoenus tendo subsp. *achaetus* T. Koyama in Micronesica 1: 104. pl. 4, fig. G. 1964; J. W. Parham, Pl. Fiji Isl. ed. 2. 394. 1972.

Perennial, with short, decumbent rhizome; culms loosely tufted or closely arranged in a row along the rhizome, 40–70 cm. tall, smooth, terete, clothed at base with a few bladeless sheaths tinged with sanguineous-purple; inflorescence an erect panicle, oblong to narrowly so in outline, 3–7 cm. long, about 1 cm. broad, subdense, bearing 2 or 3 fascicles of spikelets; bracts with a sanguineous-brown sheath, the

linear blade up to 5 cm. long; spikelets lance-ovate, more or less falcate, single or paired, laterally flattened, 4–5 mm. long, about 1.5 mm. broad, dark brown; glumes 6 or 7, the lower ones small and empty, the fruiting ones 1 or 2, lance-ovate, sometimes sparingly hispidulous on back, subdensely ciliate on the lighter colored upper margins; achenes obovoid, trigonous with conspicuous angles, 0.8–1 mm. long, smoothish, straw-colored; style 2.5 mm. long, 3-fid; hypogynous bristles none; stamens 2.

TYPIFICATION: The holotype is *Hatusima 11015* (FU), from Ponape, eastern Caroline Islands.

DISTRIBUTION: Known only from Ponape and from the single Fijian collection listed below; no altitude was given for the latter but it is probably in the nature of 500–900 m. It was obtained in flower in November, 1965.

AVAILABLE COLLECTION: VITI LEVU: NAMOSI: Track to Mt. Nambui, Korombasambasanga Range, DA 14551.

As I indicated in recently making the new combination, *Schoenus achaetus* differs specifically from *S. tendo* Hook. f., of New Zealand, in its lack of hypogynous bristles and its depauperate panicles. Its closest relative is the New Guinean *S. laevinux* (Küenth.) Ohwi, from which its brownish achenes and glabrous glumes distinguish it. The occurrence of a species in the eastern Carolines and Fiji only is an interesting and infrequent facet of distribution.

16. **RHYNCHOSPORA** Vahl, Enum. Pl. 2: 229, as *Rynchospora*. 1805 or 1806; corr. Willd. Enum. Pl. Hort. Berol. 71. 1809; Seem. Fl. Vit. 316. 1868. Nom. et orth. cons.

Perennial or annual sedges of varying size; culms scapellike or nodose and leaved at nodes; leaves basal and or cauline with grasslike blades; inflorescences of varying types, mostly consisting of terminal and lateral corymbs or panicles subtended by leafy bracts, sometimes congested in a terminal head; spikelets mostly lanceolate or ovate, slightly bilaterally flattened or terete; glumes few to many, 2-ranked or imbricated on a continuous and often flexuous rhachilla, the basal 1–few glumes small and empty, the middle 1–several large and bearing a hermaphrodite flower, the distal glumes staminate or empty; flowers hermaphrodite or staminate; hypogynous bristles 0–6; stamens 2 or 3; achenes lenticular and dorsiventrally flattened; style jointed at base, the spongy-thickened base (style base) mostly conical; stigmas 2 or undivided.

LECTOTYPE SPECIES: *Rhynchospora alba* (L.) Vahl (*Schoenus albus* L.). Typ. cons.

DISTRIBUTION: More than 250 species throughout the world, with a great species concentration in the tropical and subtropical parts of America. A single species occurs in Fiji.

1. **Rhynchospora corymbosa** (L.) Britton in Trans. New York Acad. Sci. 11: 84. 1892; Christophersen in Bishop Mus. Bull. 128: 20. 1935; Yuncker in op. cit. 184: 27. 1945; S. T. Blake in J. Arnold Arb. 29: 101. 1948; Yuncker in Bishop Mus. Bull. 220: 73. 1959; J. W. Parham in Dept. Agr. Fiji Bull. 35: 150. 1959; T. Koyama in Micronesica 1: 106. 1964; J. W. Parham, Pl. Fiji Isl. 299. 1964, ed. 2. 394. 1972.

Scirpus corymbosus L. Cent. II. Pl. 7. 1756.

Rhynchospora aurea Vahl, Enum. Pl. 2: 229. 1805 or 1806; Seem. Fl. Vit. 317. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 334. 1892; Rendle in J. Linn. Soc. Bot. 39: 179. 1909; J. W. Parham in Dept. Agr. Fiji Bull. 35: 150. 1959.

Culm arising from short but thick rhizome, 80–120 cm. tall, 3-sided, sometimes nodose, leaved, scabridulous on angles on upper part; leaves many, aggregated at base of culm and several upper ones on culm; blades broadly linear, 8–20 mm. broad, flattish, herbaceous or thin-coriaceous, gradually long-acuminate at apex; sheaths elongated, the basal ones straw-brown or light brown; corymbs 2–4, on upper part of culm, compound or decompound, rather continuous, 10–15 cm. long and broad; bracts leaflike, shorter than to much longer than corymb, sheathing at base; corymb rays many, the longer up to 12 cm. long; final raylets terminated by a cluster of 2–5 spikelets, these lanceolate or elliptic, terete, 7–10 mm. long, rusty- or orange-brown, bearing 1 fruit; glumes obscurely 2-ranked, the lower ones ovate, the upper ones oblong-ovate, 2.5–6 mm. long, membranous, light brown, 1-nerved, acute at the muticous apex; achenes obdeltoid-obovate, 3–3.5 mm. long, yellow-brown, dull, finely transversely wrinkled in median portion, coarsely undulate-rugose toward margins; style base elongate-conical, as long as or slightly longer than achene body, furrowed in median portion; style elongated, scarcely divided at apex; hypogynous bristles 6, 4–5 mm. long, brown, upwardly scabrid.

TYPEIFICATION AND NOMENCLATURE: *Scirpus corymbosus* is typified by an unspecified collection from India. For *Rhynchospora aurea*, Vahl cited many references and added: "Hab. in Surinamo, Jamaica, India *orientali*, China." The identity of the two concepts was discussed by Kern in *Reinwardtia* 6: 67. 1961.

DISTRIBUTION: Pantropical. In Fiji it is often locally common, occurring from near sea level to 825 m. in swamps and borders of creeks and small lakes in forest, in pastures, plantations, and rice fields, and along roadsides. About 45 Fijian collections are available. Flowers and fruits are seen at any season.

LOCAL NAMES AND USES: *Misimisi*; *mbelisi*; *onithi*; *love love*; *ndavandavairanduna*. In the Yasawas it is reported that the juice is used for nosebleed, and in interior Naitasiri Province a decoction of leaves is reported to make barren women fertile. It is doubtful, however, that this sedge has any real medicinal value.

REPRESENTATIVE COLLECTIONS: YASAWAS: WAYA: Yalombi, *St. John* 18080. VITI LEVU: MBA: Eastern base of Mt. Evans Range, *Smith* 4435; vicinity of Nandarivatu, *Gibbs* 869. NANDRONGA & NAVOSA: Northern portion of Rairaimatuku Plateau, *Smith* 5399; Singatoka River Valley, *O. & I. Degener* 32349. SERUA: Ndeumba, *DA* 9184 (*McKee* 2747); Tokotoko, Navua, *DA* 9433. NAMOSI: Wairofo Creek, *DA* 3819. RA: Ndombuilevu, *DA* 7860. NAITASIRI: Near Matawailevu, upper Wainimala Valley, *St. John* 18236; Vinindawa, *DA* 7799; vicinity of Nasinu, *Gillespie* 3632. TAILEVU: Waindalithi River, *DA* 7672. REWA: Naikorokoro Creek, *Meebold* 21932; Lami, *Parks* 20061. VANUA LEVU: MATHUATA: Near Ndaku, *DA* 8786; Lambasa, *Greenwood* 493. THAKAUNDROVE: Mt. Kasi, *DA* 15727; near Savusavu, *Bierhorst* F29. MOALA: *Milne* 134. MATUKU: *Milne* 117. FIJI without further locality, *U.S. Expl. Exped., Home, Home* 194.

17. GAHNIA J. R. & G. Forst. Char. Gen. Pl. 26. 1775, ed. 2. 51. 1776; Seem. Fl. Vit. 316. 1868; Benl in Bot. Arch. 40: 152. 1940; Kern in Fl. Males. I. 7: 703. 1974.

Lamprocarya R. Br. Prodr. Fl. Nov. Holl. 238. 1810.

Perennials, with short, woody, erect rhizomes, frequently growing in large tussocks; culms usually stout and tall, few- to many-nodose, bearing many leaves at base and higher; leaves with mostly coriaceous linear blades, these inrolled on usually strongly scabrous margins, narrowed from above base to a long acuminate apex, the base sheathing, usually colored with brown; ligule well developed; inflorescences paniculate, often ample, consisting of several partial panicles subtended by leaflike bracts; spikelets with several spirally imbricated glumes, 1- or 2-flowered; glumes mostly lance-ovate, the lower ones acuminate and large, empty, the upper ones smaller, the uppermost one or two subtending a hermaphrodite flower; hypogynous bristles none; stamens 2–6, the filaments often stretching after anthesis; achenes ovoid or ellipsoid, terete or trigonous, rarely obscurely 4-gonous,

shining, the endocarp thick and hard; style base not enlarged, 2- or 3-fid (rarely 4-fid with one style branch further 2-cleft).

TYPE SPECIES: *Gahnia procera* J. R. & G. Forst., the only original species.

DISTRIBUTION: Thirty to 40 species in Oceania, Malesia, and southeastern Asia including the southern Ryukyus and the Bonin Islands.

USEFUL TREATMENTS OF GENUS: Benl, G. Die Systematik der Gattung *Gahnia* Forst. Bot. Arch. **40**: 151-251. 1940. Benl, G. Nomina nova vel emendata generis *Gahniae* Forst. Repert. Sp. Nov. **49**: 30-34. 1940.

KEY TO SPECIES

- Achene yellowish to brown at maturity, $1.5-3 \times 0.8-1.2$ mm., the style persisting only as a short mucro 0.1-0.5 mm. long, the filaments after anthesis elongate, very slender, entangled, soon free from base of achene; culms 1-3 m. tall; inflorescence a lax panicle 30-90 cm. long and 5-15 cm. broad, open, manifestly paniculate, nodding. 1. *G. vitiensis*
- Achene becoming red or brick-red at maturity, $4-6.5 \times 3-4$ mm., the style 5-8 mm. long and often persisting to its full length in fruit, the filaments after anthesis not conspicuously entangled, often persistently attached to base of achene; culms 30-100 cm. tall; inflorescence a comparatively compact panicle 5-30 cm. long and 2-5 cm. broad, spike-like, erect. 2. *G. aspera*

1. *Gahnia vitiensis* Rendle in J. Linn. Soc. Bot. **39**: 179. *pl. 13, fig. 18-20*. 1909; Svenson & Uittien in Bishop Mus. Bull. **141**: 15. 1936; Benl in Flora **131**: 371. 1937, in Bot. Arch. **40**: 189. 1940; J. W. Parham in Dept. Agr. Fiji Bull. **35**: 154. 1959, Pl. Fiji Isl. 299. 1964, ed. 2. 394. 1972. FIGURES 27, 64.

Gahnia javanica sensu Seem. in Bonplandia **9**: 261. 1861, Viti, 444. 1862; non Zoll. & Moritz.

Tall perennial, growing in large clumps; rhizome short, woody; culm central and solitary to a leaf tussock, 1-3 m. tall, 5-10 mm. thick below, terete, many-nodose; leaves many, equalling or shorter than inflorescence, linear, stiff, 7-10 mm. broad, strongly inrolled on scabrous margins, gradually long-acute at apex, the sheaths yellowish or dark brown; inflorescence a large compound panicle, nodding above and bearing pendant branches, 30-90 cm. long, 5-15 cm. broad, interrupted, bearing fascicles at 8-14 nodes; bracts of fascicles with brown sheaths, the lower ones with elongated blades much surpassing fascicle; primary branches 3- to 6-nate, 8-15 cm. long, copiously further branched and bearing numerous spikelets; spikelets solitary, short-peduncled or nearly sessile, oblanceolate, 2-3 mm. long, 1-flowered; glumes 3 or 4, black- or purple-brown, minutely puberulent, the lower 2 ovate, short-awned at acute apex, the others smaller, not awned; stamens 2-4, the filaments eventually 1-1.2 cm. long, twisted; achenes obovoid, 1.7-2 mm. long, about 1 mm. broad, obtusely trigonous, maturing shining yellow-brown.

TYPEFICTION: The holotype is *Gibbs 613* (BM), collected in October 1907, in the vicinity of Nandarivatu, Mba Province, Viti Levu.

DISTRIBUTION: Endemic to Fiji, occurring at altitudes of 400-1,323 m. (highest elevation in the group) in the dense thickets and openings on ridges and crests. Flowers have been obtained between April and November and fruits between June and December.

LOCAL NAMES: *Sauninga*; *mhenithi*.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Slopes of Mt. Nairoso, eastern flank of Mt. Evans Range, *Smith 4416*; vicinity of Nandarivatu, *Degener & Ordonez 13564*, *DA 16238*; summit ridge of Mt. Tomanivi, *Gillespie 4117*, *Smith 5153*, *DA 13080*. O. & I. *Degener 32254*. NAMOSI: Korombasambasanga Range, *DA 2195*; Mt. Voma, *DA 1966*, *13982*. REWA: Mt. Korombamba, *Meebold 17006*. VANUA LEVU: THAKAUNDROVE: Summit ridge of Mt. Mbatini, *Smith 662*. TAVEUNI: *Seemann 673*; lake on main range east of Somosomo, *DA 12421*.



FIGURE 64. *Gahnia vitiensis*, from Smith 4416; A, habit, $\times 2/3$; B, part of inflorescence, $\times 5$; C, spikelet, $\times 14$; D & E, glumes, $\times 14$; F, fruit with filaments, $\times 5$; G, achene, $\times 14$. Scales = 1 mm.

2. *Gahnia aspera* (R. Br.) Spreng. Syst. Veg. 2: 114. 1825; Seem. Fl. Vit. 316. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 335. 1892; Benl in Bot. Arch. 40: 176. fig. 8. 1940; J. W. Parham in Dept. Agr. Fiji Bull. 35: 154. 1959, Pl. Fiji Isl. 298. 1964, ed. 2. 393. 1972; Kern in Fl. Males. 1. 7: 708. fig. 95. 1974.

Lamprocarya aspera R. Br. Prodr. Fl. Nov. Holl. 238. 1810.

Lamprocarya affinis sensu Seem. in Bonplandia 9: 261. 1861, Viti, 444. 1862; non Brongn.

Gahnia stokesii F. Br. in Bishop Mus. Bull. 84: 113. 1931; Svenson & Uittien in op. cit. 141: 15. 1936; J. W. Parham in Dept. Agr. Fiji Bull. 35: 154. 1959, Pl. Fiji Isl. 299. 1964, ed. 2. 394. 1972.

Stiff perennial, with short, erect rhizome; culm solitary, erect from leaf tussock, mostly 30–80 cm. tall, 3–8 mm. thick, terete, many-nodose; leaves many, much surpassing inflorescence, coriaceous, linear, 5–13 mm. broad at base of blade, noticeably narrowed upward to a very acute apex, strongly inrolled on scabrous margins, the sheath shining dark or yellowish brown; inflorescence cylindric, spikelike, rather contiguous, 5–30 cm. long, 2–5 cm. broad, bearing 7–10 clusters of partial panicles, each subtended by a long, leafy bract much surpassing inflorescence; panicles oblong-ovoid, about 3 cm. long, the peduncles single or binate, included in the brown-tinged bract sheath; spikelets densely crowded, 6–8 mm. long, 1-flowered; glumes 7 or 8, black-brown, the lower 4 or 5 empty, ovate to lance-ovate, 7–8 mm. long including the long awnlike apex, the upper 3 glumes broadly ovate, contracted at the mucronate apex; stamens 4–6; filaments accrescent, finally attaining 1–1.3 cm. in length, sparsely ciliolate on margins; achenes ovoid to ovoid-globose, subterete, 4–6.5 mm. long, 3–4 mm. across, smooth, shining dark castaneous or red-brown, contracted to a mucronulate apex.

TYPIFICATION AND NOMENCLATURE: The holotype is *R. Brown 6061* (number provided by Bennett) (BM); there are two sheets of this number at BM, one of which, from the “east coast” of Australia, is indicated by Clarke as the type specimen. The second sheet comes from Port Jackson. The type of *Gahnia stokesii* is *J. F. G. Stokes 38* (BISH HOLOTYPE), collected on the southern slope of Mt. Taraia, Raivavae, Austral Islands. Benl’s reduction of the latter to the widespread *G. aspera* seems entirely correct.

DISTRIBUTION: Malesia, Bonin Islands, northern and eastern Australia, and New Caledonia eastward to the Austral and Society Islands; subsp. *globosa* (Mann) Kern, of Hawaii, has constantly larger achenes 6–7 × 5–5.5 mm. and is sometimes considered a distinct species (St. John, List Fl. Pl. Haw. Isl. 48. 1973). In Fiji the species is comparatively infrequent (although sometimes locally common) at elevations of 100–590 m., occurring on open hillsides and in forest, thickets, and rolling country with ferns and grasses. Flowers have been collected only in July, fruit from July to February.

LOCAL NAME: *Matava*.

AVAILABLE COLLECTIONS: MAMANUTHAS: Malolo Group, NGGALITO Island: *O. & I. Degener 32248, 32249*. KANDAVU: *Seemann 672* (locality on K sheet; said by Seemann, 1868, to be from Vanua Levu); vicinity of Vunisea, *DA 9640*; hills above Namalata and Ngaloa Bays, *Smith 133*. VANUA LEVU: MATHUATA: Seanggangga Plateau, in drainage of Korovuli River, vicinity of Natua, *Smith 6870*; summit ridge of Mt. Numbuiloa, east of Lambasa, *Smith 6512*; Wainikoro River area, *Greenwood 692*. LAKEMBA: Central hills, *Bryan 533*. FIJI without further locality, *Horne 625, DA 3713*.

18. *CAREX* L. Sp. Pl. 972. 1753; Kükenth. in Pflanzenz. 38 (IV. 20): 67. 1909; Nelmes in Kew Bull. 1: 5. 1946, in op. cit. 10: 297. 1955.

Perennials, often with conspicuous rhizomes; culms central or lateral, usually leaved at base, occasionally bearing 1–several leaves above base; leaves as a rule linear, sheathing at base; inflorescences racemose or spicate, occasionally paniculate with few to several partial panicles or fascicles, sometimes reduced to a single



terminal spike, the lateral spikes of racemose or spicate inflorescences and partial panicles or fascicles subtended by a leafy bract; spikes bisexual or unisexual, in the latter case the terminal spike normally staminate and the lateral ones pistillate; glumes spirally disposed, the staminate one bearing a triandrous staminate flower, the pistillate ones subtending a utricle, a saclike structure enveloping the pistillate flower of a naked pistil; utricles closed, open only at apex by an orifice, 2-costate; achenes 3-sided or lenticular; styles exposing their divided portion (stigmas) from utricular orifice.

LECTOTYPE SPECIES: Of the 29 species originally included by Linnaeus, *Carex acuta* L. was indicated as the lectotype species by Nelves in 1951.

DISTRIBUTION: A cosmopolitan genus with more than 2,000 species, the largest genus in the family, with a high concentration of species in China and southeastern Asia. Three species occur in Fiji.

USEFUL TREATMENTS OF GENUS: Kükenthal, G. *Cyperaceae-Caricoideae*. *Pflanzenr.* **38** (IV, 20): 1-821 (*Carex*, 67-767). 1909. Nelves, E. A key to the Carices of Malaysia and Polynesia. *Kew Bull.* **1**: 5-29. 1946. Nelves, E. Notes on Cyperaceae: XXXVII. Carices of the tropical Pacific islands, loosely called Polynesia. *Kew Bull.* **10**: 297-319. 1955.

KEY TO SPECIES

Stigmas 3; achenes and utricles trigonous; inflorescences compound, consisting of several partial panicles or fascicles.

Partial inflorescences paniculate; spikes usually up to 15 mm. long, the pistillate part about 7 mm. thick.1. *C. dietrichiae*

Partial inflorescences fasciculate; spikes usually 25-40 mm. long, the pistillate part 2-3 mm. thick.2. *C. gibbsiae*

Stigmas 2; achenes and utricles lenticular; inflorescences simple, racemose.3. *C. graeffeana*

1. *Carex dietrichiae* Boeck. in *Flora* **58**: 122. 1875; Rendle in *J. Linn. Soc. Bot.* **39**: 180. 1909; Nelves in *Kew Bull.* **1**: 23. 1946, in op. cit. **10**: 303. 1955; J. W. Parham in *Dept. Agr. Fiji Bull.* **35**: 154. 1959, *Pl. Fiji Isl. ed. 2.* 390. 1972.

FIGURE 65.

Carex indica var. *milnei* Boott ex C. B. Clarke in Hook. f. *Fl. Brit. Ind.* **6**: 715. 1894.

Carex indica var. *fissilis* Kükenth. in *Pflanzenr.* **38** (IV, 20): 264, p. p. 1909.

Carex indica sensu J. W. Parham, *Pl. Fiji Isl.* 296. 1964; non L.

Tufted, with short rhizome; culms 30-150 cm. tall, smooth; leaves linear, radical and occasionally the uppermost borne on the midway portion of culm, the upper ones much surpassing the culm, 5-10 mm. broad, the sheaths brown to dark brown; inflorescence paniculate, 15-35 cm. long, interrupted and consisting of 3-8 partial panicles, these single, oblong in outline, 2-7 cm. long, 1-2.5 cm. broad; leafy bracts overtopping inflorescence, sheathing at base; spikes oblong-cylindric, 1-1.5 cm. long, the more slender staminate part longer or slightly shorter than the pistillate part, subdensely flowered; bracteoles scalelike, awned; pistillate glumes oblong to ovate-oblong, 2.5-3.5 mm. long, glabrous to sparsely hispidulous above, the upper part tinged with straw- or chestnut-brown, truncate to shallowly emarginate at apex, the greenish midvein excurrent into a scabrous awn to 3 mm. long; utricles ellipsoid, 3.7-5 mm. long, obscurely trigonous, many-veined, glabrous, the beak about 2 mm. long, oblique at orifice; achenes broadly elliptic, 3-sided, 2.5-3 mm. long, contracted above to a discoid-annulate short beak; style base slightly thickened; stigmas 3.

LECTOTYPIIFICATION AND NOMENCLATURE: Boeckeler cited *Dietrich* 644 and 653 from Queensland; in 1938 Nelves annotated no. 653 as the "type," and therefore

FIGURE 65. *Carex dietrichiae*; A, habit, $\times 1/4$; B, distal portion of inflorescence, $\times 2$; C, pistillate portion of inflorescence showing flower-enclosing utricles, $\times 20$; D, developing pistillate flower with half of the enveloping utricle removed, $\times 20$; A from *Greenwood 1214*; B-D from *Bryan 601A*.

Dietrich 653 (κ), from Port Mackay, may be taken as the lectotype. As to *Carex indica* var. *milnei*, Clarke originally cited only *Ridley* 2143a, from Pahang, Malaya. However, Nelmes (1955, cited above) assumed that the variety was actually based on Milne Fijian collections in the Boott manuscript available to Clarke. There are six Milne Fijian collections of the species at κ, three of them labelled by Boott as "*C. Milnei* Boott." Nelmes did not indicate a lectotype, but the Milne specimens are all cited below. For *C. indica* var. *fissilis*, Kükenthal listed *C. fissilis* Boott, a manuscript name, as a synonym, but the only Fijian specimen he cited was *Weber* 143. However, Clarke has noted that *Milne* 289 (κ), from Aneityum, New Hebrides, is the whole material found in the cover that Boott had designated as "*C. fissilis* B.", implying that the Milne specimen should be considered the holotype. Nelmes considers that *C. indica* L. does not occur in Fiji; the two varieties here discussed are clearly referable to *C. dietrichiae*.

DISTRIBUTION: Southeastern Asia and the Caroline Islands through Malesia to Queensland, New Caledonia, and Fiji. About 30 Fijian collections are available, occurring at elevations of 50–850 m. in various types of forest and in wet places on open slopes. Flowering and fruiting specimens have been obtained between July and December.

LOCAL NAMES: *Misimisi*; *thatha*.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Mt. Evans Range. *Greenwood* 1214; hills between Nggalawana and Nandala Creeks, south of Nauwanga, *Smith* 5837; Nandarivatu, *Gibbs* 612. SERUA: Hills between Waininggere and Waisese Creeks, between Ngaloa and Wainiyambia, *Smith* 9651. NAMOSI: Hills north of Wainavindrau Creek, *Smith* 8412. NAITASIRI: Tholo-i-suva, *DA* 10910; vicinity of Tamavua, *Gillespie* 2432. REWA: Namboro, *DA* 5917. VITI LEVU without further locality, *Milne* 16, 23. OVALAU: *Milne* 274; *Bryan* 601A; slopes of Mt. Korotolutolu, west of Thawathi, *Smith* 8011. NGAU: *Milne* 173, 216, s. n. VANUA LEVU: MATHUATA: Seanggangga Plateau, *DA* 10490; Lambasa, *Greenwood* 498.

2. *Carex gibbsiae* Rendle in J. Linn. Soc. Bot. 39: 180. 1909; Nelmes in Kew Bull. 1: 25. 1946, in op. cit. 10: 308. 1955; J. W. Parham in Dept. Agr. Fiji Bull. 35: 154. 1959, Pl. Fiji Isl. 296. 1964, ed. 2. 390. 1972.

Carex vitiensis St. John in Pacific Sci. 1: 116. fig. 1. 1947.

Densely tufted; rhizome short, clothed with reddish brown scales and their fibrous remnants; culms 60–100 cm. tall, smooth, leaved at base; leaves linear, 4–7 mm. broad, surpassed by culms; sheaths reddish brown; inflorescence with 6–8 distant fascicles, linear-oblong in outline, 40–55 cm. long; fascicles with 5–15 spikes, 5–8 cm. long; leafy bracts with sheathing base, the lower ones longer than the subtending fascicle; spikes slenderly linear, androgynous, 2–4 cm. long, the pistillate part 1.5–3 mm. thick, usually longer than the more slender staminate part; peduncles filiform, exserted; pistillate glumes oblong-ovate, 2–3 mm. long, obtuse at apex, slightly hispidulous above, pale to pale brownish green, the margins broadly hyaline, the green keel ending in a short awn about 1 mm. long; utricles oblong-elliptic, 5–6 mm. long, flattened-trigonal, several-veined and hispidulous on nerves and along edges, straw-colored; beak about 2 mm. long, hispidulous on margins, dorsally oblique at the 2-toothed orifice; achene tightly enveloped, oblong, 2–3 mm. long, short-stipitate, contracted at apex below the thickened-annulate beak; stigmas 3.

TYPIFICATION AND NOMENCLATURE: The holotype is *Gibbs* 795 (BM), collected in October, 1907, near the summit of Mt. Tomanivi, Mba Province, Viti Levu. *Carex vitiensis* is based on *St. John* 18330 (BISH HOLOTYPE), collected Aug. 18, 1937, at Taunaisali, Wainisavulevu–Numbulolo divide, on the central plateau between the Wainimala and Singatoka Rivers, near the boundary between Nandronga & Navosa

and Naitasiri Provinces, Viti Levu. In describing the novelty, St. John contrasted it only with the Australian *C. longebrachiata* Boeck.; he apparently overlooked *C. gibbsiae*, from which, as pointed out by Nelmes (1955, cited above), *C. vitiensis* is not distinguishable.

DISTRIBUTION: Endemic to Fiji and thus far known only from seven collections from upland Viti Levu, where it occurs from 1,050 m. to the highest point of the group, 1,323 m., in mossy forest on ridges and in swampy rain forest. Flowering and fruiting material has been obtained between July and September.

LOCAL NAME AND USE: For the type collection of *Carex vitiensis*, St. John reports the local name *mhenethi* and states that juice from the crushed leaves is used for asthma.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Summit and summit ridge of Mt. Tomanivi, *Smith* 5164, *DA* 4192, 4193, 4194. RA: Ridge from Mt. Namama (east of Nandarivatu) toward Mt. Tomanivi, *Smith* 5707.

3. *Carex graeffeana* Boeck. in *Flora* **58**: 123. 1875; Kuenth. in *Pflanzenr.* **38** (IV. 20): 403, p. p. 1909; Rendle in *J. Linn. Soc. Bot.* **39**: 180. 1909; Christophersen in *Bishop Mus. Bull.* **128**: 24. 1935; Nelmes in *Kew Bull.* **1938**: 109. 1938, in op. cit. **1**: 28. 1946, in op. cit. **10**: 317. 1955; J. W. Parham in *Dept. Agr. Fiji Bull.* **35**: 154. 1959, *Pl. Fiji Isl.* 296. 1964, ed. 2. 390. 1972. FIGURE 66.

Carex rechingeri Palla in *Oesterr. Bot. Z.* **57**: 424. 1907.

Carex graeffeana var. *samoensis* Nelmes in *Kew Bull.* **1938**: 110. 1938, in op. cit. **1**: 28. 1946.

Perennial, tufted with short rhizome; culms erect, 70–100 cm. tall, scabrid on upper angles, usually 1-leaved toward middle; leaves many, linear, surpassing culms, 5–12 mm. broad, recurved on margins when dry; sheaths membranous, red-



FIGURE 66. *Carex graeffeana* from Namosi Province, Viti Levu, showing foliage and inflorescence, from *Smith* 8629.

brown; spikes 15–20, the upper ones subfastigiate, the lower ones more spaced, erect to inclined, cylindric; uppermost 2–4 spikes staminate or androgynous, much smaller than the others, 1–2 cm. long, the other spikes androgynous, up to 10 cm. long; peduncles slender; lower leafy bracts slightly overtopping inflorescence, the upper ones setaceous and shorter, none sheathing; pistillate glumes oblong to ovate-oblong, rounded at apex, 1.5–2.5 mm. long, dark red, but the upper margins whitish-hyaline, the greenish midvein ending in a short awn about 0.3 mm. long; utricles elliptic, lenticular, 1.8–2.5 mm. long, stramineous-green, many-nerved, gradually tapering above to a subterete beak; achenes obovate-elliptic, about 1 mm. long, rounded at apex; style short, 2-leaf.

TIPIFICATION AND NOMENCLATURE: The holotype is *Graeffe 1228* (κ), collected on the island of Ovalau, probably in 1864. *Carex rechingeri* is typified by *Rechinger 1106*, collected in July, 1905, on Mt. Mauga Afi, Savaii, Samoa. *Carex graeffeana* var. *samoensis* is typified by *Vaupel 467* (κ HOLOTYPE), obtained Nov. 4, 1905, at Matavanu Crater, Savaii, Samoa. In 1938 (cited above), Nelmes fully described *C. graeffeana*, considering it a Fijian endemic and removing the Philippine and Bornean specimens so identified by Kükenthal; but he added an endemic Samoan variety utilizing a different epithet than Palla's. However, in 1955 (cited above) Nelmes reduced the Samoan variety outright.

DISTRIBUTION: Limited to Fiji and Samoa; the Malesian collections sometimes referred here are doubtful. In Fiji *Carex graeffeana* is infrequent, known only from Viti Levu and Ovalau at elevations of 250–1,200 m. It occurs in dense forest, often along streams, and in wet, open, sunny places. From the limited number of collections available, fertile material is known only in September and October.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Mt. Evans Range, *Greenwood 120, 120A*; summit of Mt. Nanggaranambuluta, east of Nandarivatu, *R. A. Lever*, Oct. 13, 1942; upper slopes of Mt. Tomanivi, *Gibbs 796, DA 3705, 3706, 13035*. NANDRONGA & NAVOSA-SERUA boundary: Summit of Mt. Tuvutau, *DA 14621*. NAMOSI: Northern base of Korombasambasanga Range, in drainage of Wainavindrau Creek, *Smith 8629*. FIJI without further locality, *Gillespie 3807*.

ORDER BROMELIALES

FAMILY 34. BROMELIACEAE

BROMELIACEAE Juss. Gen. Pl. 49, as *Bromeliae*. 1789.

Terrestrial or epiphytic, often xerophytic herbs, infrequently woody at base; leaves usually spirally arranged in a rosette on a short, erect, congested axis, usually rigidly lorate, often spiny-serrate, with characteristic minute peltate scales; inflorescence a terminal head, spike, raceme, or panicle, often with colored bracts; flowers actinomorphic or essentially so, usually ♀; perianth segments 6, biseriate, the outer series calycine, imbricate, the inner series corolline, free or variously connate, imbricate, often with ventral scales or nectaries; stamens 6, free or partly adnate to perianth segments, the anthers usually free, linear, versatile, 2-locular, dehiscing by longitudinal, introrse slits; ovary superior to inferior (the latter in all our genera), 3-locular, the ovules numerous (infrequently few) in each locule on axile placentas, the style obvious, often elongate, the stigmas 3, sometimes contorted; fruit usually fleshy and indehiscent, rarely capsular, the seeds with abundant endosperm and a small embryo.

DISTRIBUTION: A family of 50–60 genera and about 2,000 species, limited to tropical and subtropical America except for one species in western Africa.

Only three species in as many genera have been recorded from Fiji, all cultivated, although the pineapple is sparingly naturalized. It seems unlikely that these are

the only bromeliads cultivated in Fiji, as the family includes many showy and popular garden plants which are often grown in private gardens.

KEY TO GENERA

- Ovaries entirely immersed in the thick inflorescence rachis and adnate to it; inner perianth segments less than 3 cm. long, each with 2 ventral, basally thickened ridges; fruit syncarpous 1. *Ananas*
 Ovaries not immersed in the inflorescence rachis; inflorescence pedunculate; inner perianth segments with ventral, basal or subbasal, double scales; fruit an indehiscent berry.
 Flowers small, the inner perianth segments rarely more than 2 cm. long. 2. *Aechmea*
 Flowers larger, the inner perianth segments usually more than 4 cm. long. 3. *Billbergia*

1. *ANANAS* Mill. Gard. Dict. Abridg. ed. 4. 1754.

Stoloniferous, terrestrial, short-stemmed herbs with linear, spiny-margined leaf blades; inflorescence densely spicate-paniculiform, the rachis of each spike thick, with a persistent tuft of sterile bracts or small leaves; flowers with the ovary immersed in the rachis and adnate to it, emergent, the outer perianth segments short, the inner perianth segments free, each with 2 ventral, basally thickened ridges; stamens free, not exserted; ovules crowded near apices of ovary locules; fruit syncarpous, broadly ellipsoid, fleshy, the seeds small, often abortive.

TYPE SPECIES: *Bromelia ananas* L. (= *Ananas comosus* (L.) Merr.).

DISTRIBUTION: About five species in tropical America, including the widely cultivated pineapple.

1. *Ananas comosus* (L.) Merr. Interpret. Rumph. Herb. Amb. 133. 1917; A.C. Sm. in Sargentia 1: 6. 1942; Yuncker in Bishop Mus. Bull. 178: 31. 1943, in op. cit. 184: 28. 1945, in op. cit. 220: 76. 1959; J.W. Parham, Pl. Fiji Isl. 258. 1964, ed. 2. 352. 1972.

Bromelia ananas L. Sp. Pl. 285. 1753.

Bromelia comosa L. Herb. Amb. 21. 1754, Amoen. Acad. 4: 130. 1759.

Ananassa sativa Lindl. in Bot. Reg. 13: sub t. 1068, nom. nud. 1827; Seem. Viti, 444. 1862.

Ananas sativus J.A. & J.H. Schultes, Syst. Veg. 7: 1283. 1830; Christophersen in Bishop Mus. Bull. 128: 47. 1935.

Ananassa sativa var. *prolifera* Seem. Viti, 444, nom. nud. 1862.

The common pineapple is a short-stemmed, spiny herb, widely cultivated in Fiji and occasionally becoming naturalized in low elevation forest.

TIPIFICATION AND NOMENCLATURE: Linnaeus gave several earlier references for *Bromelia ananas*, but I have not noted a lectotypification. *Ananas sativus* is based on *B. ananas* L. The oldest available epithet is found in *Bromelia comosa*, the whole basis of which is *Anassa domestica* Rumph. Herb. Amb. 5: 227. t. 81. 1747. The type locality therefore is Amboina, where Rumphius knew the plant in cultivation.

DISTRIBUTION: Apparently a domesticated cultigen originally from the Paraná-Paraguay River area of South America, the pineapple had spread throughout much of tropical America in pre-Columbian times and is now cultivated throughout the tropics.

LOCAL NAMES AND USE: *Mbalawa ni vavalangi*; *vandra*; *andras*; *pineapple*. The edible pineapple was an early introduction into Fiji and is widely cultivated there, although not on a commercial scale.

AVAILABLE COLLECTIONS: VITI LEVU: NANDRONGA & NAVOSA: Uluvalu, vicinity of Mbalo, near Vatu-karasa. Degener 15238. NAITASIRI: Toninaiwau, Tholo-i-suva, DA 16989.

Interesting background information on the origin, spread, cultivation, and uses of the pineapple has been supplied by Burkill (Dict. Econ. Prod. Malay Penins. ed. 2. 149-155. 1966) and Purseglove (Trop. Crops, Monocot. 76-91. 1972).

2. *Aechmea* Ruiz & Pavon, Fl. Per. Chil. Prodr. 47. 1794. Nom. cons.

Usually epiphytic plants with linear or linear-lanceolate, coriaceous, often spiny-margined leaf blades; inflorescence spicate or paniculate, the flowers sessile, each solitary in the axil of a usually small bract, the outer perianth segments free or connate at base, the inner ones free, connivent distally, each with a ventral, basal, double scale; stamens included, free or the inner ones basally adnate to perianth segments; ovary inferior, the ovules few to numerous, the style filiform, the stigmas often contorted; fruit an indehiscent berry.

TYPE SPECIES: *Aechmea paniculata* Ruiz & Pavon.

DISTRIBUTION: About 150 species in tropical America, many of them now widespread in cultivation.

1. *Aechmea fulgens* var. *discolor* (C. Morren) Brongn. ex Baker, Handb. Bromel. 52. 1889; J. W. Parham, Pl. Fiji Isl. ed. 2. 352. 1972.

Aechmea discolor C. Morren in Ann. Soc. Roy. Agric. Gand 2: 175. pl. 65. 1846.

This attractive bromeliad, sparsely cultivated in Fiji, is normally an epiphytic herb but may also be grown terrestrially. Its leaf blades are green above and maroon beneath, and the plant attains a height of about 50 cm. The inner perianth segments are blue to violet at anthesis, becoming red, and not much exceeding 1 cm. in length; the fruit is red. The only available voucher was in fruit in May.

TYPEFIICATION: The holotype is *Quesnel* (P), from a cultivated plant that originally came from Brazil (cf. L. B. Smith in Smithsonian Misc. Collect. 126 (1): 203. 1955).

DISTRIBUTION: Tropical South America, but now widely cultivated.

LOCAL NAME AND USE: "*Bromeliad*." Ornamental.

AVAILABLE COLLECTION: VITI LEVU: NAITASIRE: Toninaiwau, Tholo-i-suva, DA 16944.

3. *BILLBERGIA* Thunb. Pl. Bras. Dec. 3: 30. 1821.

Epiphytic plants with linear or channel-shaped, usually spiny-margined leaf blades; inflorescence large, spicate, racemiform, or paniculate, the flowers comparatively large, the perianth segments free, the inner ones recurved or revolute at anthesis, each with a ventral, basal or subbasal, incised scale; stamens equal to or shorter than inner perianth segments, the inner ones sometimes basally adnate to perianth segments; ovary inferior, the ovules numerous, the stigmas sometimes contorted; fruit a dry berry.

TYPE SPECIES: *Billbergia speciosa* Thunb.

DISTRIBUTION: About 50 species in tropical and subtropical America, some of them often cultivated elsewhere.

1. *Billbergia pyramidalis* (Sims) Lindl. var. *pyramidalis*; J. W. Parham, Pl. Fiji Isl. ed. 2. 352. 1972.

Bromelia pyramidalis Sims in Bot. Mag. 42: pl. 1732. 1815.

Billbergia pyramidalis Lindl. in Bot. Reg. 13: sub t. 1068. 1827.

A normally epiphytic bromeliad which may be grown terrestrially in cultivation, this attractive species has leaf blades up to 1 m. long with pale, transverse bands beneath. The peduncular bracts are pink to orange and may be up to 8 cm. long; the inner perianth segments, about 5 cm. long, are bright red, paler at base and bluish at apex. The only available collection was flowering in March.

TYPEFIICATION: The type was a cultivated plant grown from a shipment sent from Rio de Janeiro, Brazil.

DISTRIBUTION: Brazil, now frequently cultivated.

LOCAL NAME AND USE: "*Bromeliad*." Ornamental.

AVAILABLE COLLECTION: VITI LEVU: NAITASIRE: Toninaiwau, Tholo-i-suva, DA 16434.

ORDER COMMELINALES

FAMILY 35. COMMELINACEAE

COMMELINACEAE R. Br. Prodr. Fl. Nov. Holl. 268, as *Commelineae*. 1810.

Usually perennial, rhizomatous herbs with jointed and succulent stems; leaves alternate, with basal tubular sheaths, the blades with parallel nerves; inflorescences terminal, axillary, or leaf-opposed, composed of cincinni (indeterminate, monochasial, scorpioid cymes), these rarely solitary, usually aggregated into a thyrses or panicle or sessile cluster; flowers actinomorphic or slightly zygomorphic, usually ♂; perianth biseriata, the outer series calycine, composed of 3 usually free, imbricate segments, the inner series petaloid, usually with 3 free and imbricate segments or these rarely united proximally, colored and often ephemeral; stamens usually 6, sometimes fewer by abortion and only 3 (or 1) fertile, the filaments usually free, the anthers basifixed, the locules contiguous, opening by longitudinal slits or rarely by apical pores; ovary superior, usually 3-locular, the ovules few to solitary in each locule on axile placentas, orthotropous, the style terminal, simple, the stigma often small and capitate, rarely 3-parted; fruit usually a thin-walled loculicidally dehiscent capsule, rarely fleshy and indehiscent, the seeds few to many, often crowded, rarely arillate, with abundant endosperm and a small embryo.

DISTRIBUTION: A family of 38-45 genera and about 1,000 species in the tropics and subtropics of both hemispheres.

USEFUL TREATMENTS OF FAMILY: Brenan, J. P. M. The classification of Commelinaceae. J. Linn. Soc. Bot. 59: 349-370. 1966. Tomlinson, P. B. Anatomical data in the classification of Commelinaceae. Op. cit. 59: 371-395. 1966. Tomlinson, P. B. Commelinaceae. In: Metcalfe, C. R. (ed.). *Anatomy of the Monocotyledons* 3: 12-63. 1969.

Six genera of Commelinaceae, each represented by a single species, are recorded from Fiji. Of the six species, four occur in cultivation (two of them being sparingly naturalized) and two are presumably indigenous, although it cannot be said positively whether one or both of them may have been adventives.

KEY TO GENERA

Fertile anthers opening by slits; seeds exarillate; sprawling or low herbs.

Ultimate inflorescence unit an individual cincinnus or these aggregated into a thyrses but not united into a single bifacial structure; fertile stamens 3.

Inflorescences terminal, not subtended by a spathaceous bract, the cincinni aggregated into a thyrses. 1. *Aneilema*

Inflorescences leaf-opposed, enclosed by a spathaceous bract and composed of 1 or 2 cincinni. 2. *Commelina*

Ultimate inflorescence a pair of sessile cincinni with their main axes none or abbreviated and united into a single more or less bifacial structure; fertile stamens 6.

Inner perianth segments free; plants subcaulescent. 3. *Rhoeo*

Inner perianth segments connate proximally into a tube; plants with the main stem obvious, monopodial.

Outer perianth segments connate; inner perianth segments highly connate, forming a distinct tube. 4. *Zebrina*

Outer perianth segments free; inner perianth segments connivent into an inconspicuous tube. 5. *Setcreasea*

Fertile stamens 5 or 6, the anthers opening by pores; inflorescence a terminal thyrses, without spathaceous bracts; seeds black, surrounded by a coral-red aril; robust, scrambling or climbing plants to 2 m. or more tall. 6. *Dichorisandra*

1. ANEILEMA R. Br. Prodr. Fl. Nov. Holl. 270. 1810; Seem. Fl. Vit. 314. 1868; C. B. Clarke in DC. Monogr. Phan. 3: 195. 1881.

Plants with a monopodial stem; leaves sessile or short-petiolate; inflorescence terminal, the cincinni somewhat elongate, aggregated into a thyrses, the pedicels subtended by amplexicaul bracts; flowers slightly zygomorphic, the inner perianth



segments free, equal or subequal; fertile stamens 3 (rarely 2), the staminodes none or 2–4; ovary 3-locular, each locule with 1–many ovules; fruit a dehiscent capsule, the seeds exarillate.

TYPE SPECIES: Brown included ten species in his genus, and I have not noted a suitable lectotypification. Although he used feminine terminations for his specific epithets, those generic names derived from Greek words ending in *-ma* should be treated as neuter. *Aneilema* is now generally used as neuter, as by Clarke and others.

DISTRIBUTION: About 100 species in the warmer parts of both hemispheres, but mostly in the Old World. A single apparently indigenous species occurs in Fiji.

1. *Aneilema vitiense* Seem. in Bonplandia 9: 260, nom. nud. 1861, Viti, 443, nom. nud. 1862, Fl. Vit. 314, pl. 96. 1868; C. B. Clarke in DC. Monogr. Phan. 3: 220. 1881; Drake, Ill. Fl. Ins. Mar. Pac. 320. 1892; Christophersen in Bishop Mus. Bull. 128: 48. 1935; Yuncker in op. cit. 184: 28. 1945, in op. cit. 220: 77. 1959; B. E. V. Parham in New Zealand Dept. Sci. Indust. Res. Inform. Ser. 85: 81. 1972.

FIGURE 67A & B.

Aneilema vitiensis Seem. ex J. W. Parham, Pl. Fiji Isl. 257. 1964, ed. 2. 351. 1972.

Rhopalephora vitiensis Faden in Phytologia 37: 480. 1977.

This species is occasional, but not abundant, in Fiji at elevations from near sea level to 500 m., in openings in forest, swampy pastures, meadows, and open grassy areas, and along roadsides. It is an herb, sprawling at base but with branches ascending 10–60 cm. The petals are white to pale blue, and flowers may be found throughout the year.

TYPIFICATION: The holotype is *Seemann 643* (κ), collected on Viti Levu but without further data.

DISTRIBUTION: Fiji, Samoa, and Tonga, although rare in the latter archipelago. I believe that specimens from the Caroline and Solomon Islands may also be referred to this species, but I am inclined to question its occurrence in the Philippines. R. B. Faden (in Phytologia 37: 479–481. 1977) proposes to separate four species, including *Aneilema vitiense*, into the genus *Rhopalephora* Hassk. (in Bot. Zeitung 22: 58. 1864); his later studies may justify this conclusion. In cleared, pastured areas, such as those around Vunindawa, the available specimens are more depauperate than those from forested areas and suggest the possibly adventive nature of the species. However, on the basis of present evidence, I believe that one must consider it indigenous in the Fijian Region.

LOCAL NAMES AND USE: *Thomboi*, *thombula*, *luna*, *ai rongorongo*; the plant is said to be used for flavoring shellfish soup (*St. John 18210*).

AVAILABLE COLLECTIONS: VITI LEVU: NAITASIRI: Wainamo Creek, Matawailevu, Wainimala Valley, *St. John 18210*; Vunindawa, *DA 7798, 8431, 8450, 11037, 11889, 13273*; Viria, *Meebold 16505*. TAILEVU: Wailotua Cave, *DA 9405*. REWA: Lami, *Tothill 911*; Suva, *DA 9004*. VITI LEVU without further locality, *Milne 179*. VANUA LEVU: THAKAUNDROVE: Slope of Uluinambathi Mt., Savusavu Bay region, *Degener & Ordóñez 13929*. FIJI without further locality, *Horne 111, Gillespie 2611*.

2. *COMMELINA* L. Sp. Pl. 40. 1753; C. B. Clarke in DC. Monogr. Phan. 3: 138. 1881. *Commelyna* (orth. mut.) Seem. Fl. Vit. 313. 1868.

FIGURE 67. A & B, *Aneilema vitiense*, from *Degener & Ordóñez 13929*; A, portion of a branch with a terminal thyrse, × 1/2; B, portion of inflorescence with a developing fruit, × 4. C & D, *Commelina diffusa*, from *DA 11091*; C, branchlet tip with leaf-opposed inflorescence, × 2; D, inflorescence with bract spread open, × 4.

Plants with the main stem partly monopodial, sympodial in the inflorescence region; leaves sessile or short-petiolate; inflorescence leaf-opposed, enclosed by a spathaceous bract, composed of 1 or 2 cincinni, these with short axes and not united, the pedicels subtended by short bracts or these lacking; flowers zygomorphic, the outer perianth segments unequal, the 2 larger ones often connate at base, the inner perianth segments unequal, the lower one reduced; fertile stamens 3, antiscous, the staminodes 3, posticous; ovary 3-locular, each locule with 1 or 2 ovules or sometimes one locule lacking an ovule; fruit a dehiscent capsule, the seeds exarillate.

LECTOTYPE SPECIES: *Commelina communis* L. (vide Britton & Brown, Ill. Fl. N. U. S. ed. 2. 1: 457. 1913), one of Linnaeus's nine original species.

DISTRIBUTION: Pantropical, with 200–250 species, of which one occurs in Fiji.

1. *Commelina diffusa* Burm. f. Fl. Ind. 18. t. 7, fig. 2. 1768; Yuncker in Bishop Mus. Bull. 178: 31. 1943, in op. cit. 184: 28. 1945, in op. cit. 220: 77. 1959; Sykes in New Zealand Dept. Sci. Indust. Res. Bull. 200: 224. 1970; J. W. Parham, Pl. Fiji Isl. ed. 2. 351. 1972.

FIGURE 67C & D.

Commelina virginica sensu Forst. f. Fl. Ins. Austr. Prodr. 6. 1786; non L.

Commelina pacifica Vahl, Enum. Pl. 2: 168. 1805 or 1806; Seem. Fl. Vit. 313, as *Commelina p.* 1868; J. W. Parham, Pl. Fiji Isl. 257. 1964; B. E. V. Parham in New Zealand Dept. Sci. Indust. Res. Inform. Ser. 85: 81. 1972.

Commelina communis sensu Seem. in Bonplandia 9: 260. 1861, Viti, 443. 1862; non L.

Commelina nudiflora sensu Drake, Ill. Fl. Ins. Mar. Pac. 320. 1892; Christophersen in Bishop Mus. Bull. 128: 48. 1935; Greenwood in Proc. Linn. Soc. 154: 104. 1943; J. W. Parham in Dept. Agr. Fiji Bull. 35: 141. fig. 71. 1959; non L.

This widespread species is found in Fiji from near sea level to 600 m. in wet places in forest and in the open, on sunny stream banks, along trails, in cleared areas and in damp pastures, and along roadsides. It is a sprawling herb with ascending branches to 10–75 cm.; the inflorescence-enclosing bracts are green and the inner perianth segments are pale to bright blue. It is seen in flower throughout the year.

TIPIFICATION AND NOMENCLATURE: The original material came from India ("Habitat Coromandeli"), but Burman did not cite a specimen; his description and illustration may serve as the type. *Commelina pacifica* is based on Forster's concept of *C. virginica*, and its type is therefore the specimen from Tongatapu collected by the Forsters on the second Cook expedition.

DISTRIBUTION: Tropical Asia and extending eastward into Polynesia, including Hawaii. As in the case of *Aneilema vitiense*, this abundant *Commelina* gives the impression of being a naturalized adventive. However, both species may be vagile enough to have reached the Fijian Region without the aid of man. Seemann believed them both to be indigenous, and the *Commelina* was obviously present in Tonga by the eighteenth century. It is probably best to treat both species as indigenous in Fiji. More than 30 Fijian collections represent *C. diffusa*.

LOCAL NAMES AND USES: *Ai rorongi*; *ai rorongorongo*; *rongomatailevu*; *thombulambula*; *matembulambula*; *ndrano*; *ndulundauwere*; *luna*; *tho nggalonggalo*. There are many reports of the medicinal properties of this apparently well-known plant; its juice is used for curing wounds, for inflamed eyes, and as a digestive aid, and the species is said to be used during pregnancy and as part of an external remedy for bone fracture.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: North of Natalau, Degener 14997; mountains near Lautoka, Greenwood 325A; eastern base of Mt. Evans Range, Smith 4463. SERUA: Ndeumba, DA 8641. NAITASIRI: Near Vunindawa, DA 8441; Cunningham dairy farm, DA 11091; Nandurulou-

Iou, *DA* 9569; Nasinu, *DA* 11178. TAILEVU: Mburua, *Weiner* 145; Naikale, *DA* 5658. REWA: Nukula Island, *Tohill* 906. VANUA LEVU: MATHUATA: Lambasa, *Greenwood* 672. THAKAUNDROVE: Savasavu, *DA* 8870; Ndrawa, *DA* 14324. TAVEUNI: Somosomo, *Seemann* 642; Tavuki, *DA* 8932. ONEATA: *Bryan* 487.

3. *Rhoeo* Hance ex Walp. *Ann. Bot. Syst.* **3**: 659. 1852; C. B. Clarke in DC. *Monogr. Phan.* **3**: 316. 1881.

Subcaulescent, robust plants, with a rosette of ensiform leaves; inflorescence composed of paired, sessile cincinni, these with very short axes, united into bifacial units conrescent with the peduncle and subtended by a pair of spathe-like, boat-shaped bracts; flowers actinomorphic, the inner perianth segments free; fertile stamens 6; ovary sessile, 3-locular, each locule with 1 ovule; fruit a dehiscent capsule, sometimes with only 2 well-developed locules, the seeds exarillate.

TYPE SPECIES: *Rhoeo discolor* (L'Hér.) Hance ex Walp. (*Tradescantia discolor* L'Hér.) = *R. spathacea* (Sw.) Stearn.

DISTRIBUTION: A genus of a single species indigenous in tropical and subtropical America.

1. *Rhoeo spathacea* (Sw.) Stearn in *Baileya* **5**: 198. *fig.* 57. 1957; Sykes in New Zealand Dept. Sci. Indust. Res. Bull. **200**: 225. 1970; J. W. Parham, *Pl. Fiji Isl.* ed. 2. 351. 1972.

Tradescantia spathacea Sw. *Nov. Gen. & Sp. Prodr.* **57**. 1788.

Tradescantia discolor L'Hér. *Sert. Angl.* **8**. (Jan.) 1789, t. 12. 1790.

Rhoeo discolor Hance ex Walp. *Ann. Bot. Syst.* **3**: 660. 1852; C. B. Clarke in DC. *Monogr. Phan.* **3**: 316. 1881; Yunker in Bishop Mus. Bull. **178**: 32. 1943, in op. cit. **220**: 78. 1959; J. W. Parham, *Pl. Fiji Isl.* 258. 1964.

This well-known ornamental is both cultivated and naturalized at low elevations in Fiji; it often occurs as an epiphyte, on stone or coral walls, or on rocky cliffs. It is a short-stemmed herb 25–60 cm. high, the leaf blades reddish purple beneath; the conspicuous bracts are purple without and pink within, the perianth is white, and the anthers are yellow. The only available Fijian specimen was in flower in February.

TYPEIFICATION AND NOMENCLATURE: Although the type of *Tradescantia spathacea* was collected by Swartz in Jamaica from a cultivated plant, it had been introduced there from the Caribbean coast of Nicaragua. The obviously similar *T. discolor* was based on a living plant at Kew originally from tropical America.

DISTRIBUTION: Although native in tropical and subtropical America, this attractive and curious plant is now widely grown in the tropics and is frequently naturalized. It is much more abundant in Fiji than the single collection suggests.

LOCAL NAME AND USE: *Moses in a boat*. Ornamental; an early introduction, according to Parham.

AVAILABLE COLLECTION: VITI LEVU: NAITASIRI: Toninaiwau, Tholo-i-suva, *DA* 16713.

4. *ZEBRINA* Schnizl. in *Bot. Zeitung* **7**: 870. 1849; C. B. Clarke in DC. *Monogr. Phan.* **3**: 317. 1881.

Plants with the main stem monopodial, creeping or pendulous; inflorescence composed of paired, sessile cincinni, these with very short axes, united into bifacial units, subtended by leafy bracts; flowers actinomorphic, the outer perianth segments connate, the inner perianth segments highly connate into a long, narrow tube, distally ovate or oblong; fertile stamens 6, borne in throat of the inner perianth; ovary sessile, 3-locular, each locule with 2 superposed ovules; fruit a dehiscent capsule, the seeds 1 or 2 per locule, exarillate.

TYPE SPECIES: *Zebrina pendula* Schnizl., the only original species.

DISTRIBUTION: Tropical and subtropical North America, with four or five species.

1. *Zebrina pendula* Schnizl. in Bot. Zeitung 7: 870. 1849; C.B. Clarke in DC. Monogr. Phan. 3: 318. 1881; Yuncker in Bishop Mus. Bull. 178: 32. 1943, in op. cit. 220: 78. 1959; J. W. Parham, Pl. Fiji Isl. 258. 1964, ed. 2. 351. 1972; Sykes in New Zealand Dept. Sci. Indust. Res. Bull. 200: 225. 1970.

Tradescantia zebrina Hort. ex Heynh. Nomencl. Bot. Hort. 2: 735, nom. nud. 1846.

In Fiji this species occurs both cultivated and naturalized at low elevations. It is a sprawling herb, sometimes forming a ground cover, the stem and leaves being purple-tinged. The inflorescence-subtending bracts are purple; the outer perianth segments are whitish; the tube of the inner segments is also essentially white, while their lobes are rich blue or pinkish purple; the filaments are rich blue and the anthers white. Flowers have been noted between May and December.

TIPIFICATION: The type was a cultivated plant said to have come from South America.

DISTRIBUTION: Probably a native of Mexico rather than South America, the species is now widely cultivated and frequently naturalized.

USE: Ornamental; no local name has been noted in Fiji.

AVAILABLE COLLECTIONS: VITI LEVU: NAITASIRI: Koroniua, DA 12119. REWA: Suva, DA 12609, 13278. OVALAU: Lovoni Village, Smith 7490. VANUA LEVU: THAKAUNDROVE: Natimbua, DA 13145.

5. *Setcreasea* K. Schum. & Sydow in Just's Bot. Jahresber. 27 (1): 452. 1901.

Trelesea Rose in Contr. U.S. Nat. Herb. 5: 207. 1899; non *Treleasia* Speg. (1896).

Similar to *Zebrina* but with the outer perianth segments free and the inner segments merely connivent into an inconspicuous tube.

TYPE SPECIES: *Trelesea brevifolia* (Torr.) Rose (*Tradescantia leiandra* Torr. var. *brevifolia* Torr.) = *Setcreasea brevifolia* (Torr.) Rose. *Setcreasea* is a substitute name for *Trelesea* Rose (non *Treleasia* Speg., 1896).

DISTRIBUTION: Tropical and subtropical North America, with about nine species.

1. *Setcreasea purpurea* B.K. Boom in Acta Bot. Neerl. 4: 167. fig. 1. 1955; J.W. Parham, Pl. Fiji Isl. ed. 2. 351. 1972.

As it occurs as a cultivated plant near sea level in Fiji, this species is a semiprosstrate herb with deep purple leaves and stems and with ascending branches 15–20 cm. high. Its inflorescence-subtending bracts are purple or deep purple; its inner perianth is pale to rich pink; its filaments and style are white distally; and its anthers are yellow. Flowers have been noted in February and April.

TIPIFICATION: The species is based on a cultivated plant in the Botanical Gardens at Darmstadt, Germany, introduced by C. A. Purpus and probably indigenous in Mexico. The holotype, from this plant, is Boom 28046 (L).

DISTRIBUTION: Presumably native in Mexico and perhaps also farther south, this species is often seen in cultivation. It is moderately common in Fiji, although that is not indicated below.

USE: Ornamental.

AVAILABLE COLLECTIONS: VITI LEVU: NAITASIRI: Toninaiwau, Tholo-i-suva, DA 16724. REWA: Suva, in private garden, DA 16481.

6. *Dichorisandra* Mikan, Del. Fl. Faun. Bras. t. 3. 1820; C.B. Clarke in DC. Monogr. Phan. 3: 272. 1881. Nom. cons.

Scrambling or climbing plants with a monopodial stem; inflorescence a terminal thyse, lacking spathaceous bracts, the cincinni elongate, arising singly; flowers slightly zygomorphic, subtended by small, amplexicaul bracts; inner perianth segments free; fertile stamens 5 or 6, the anthers opening by pores; ovary sessile, 3-locular, each locule with 2-6 ovules, the style filiform; fruit a dehiscent capsule, the seeds black, with a coral-red aril.

TYPE SPECIES: *Dichorisandra thyrsoiflora* Mikan, the only original species.

DISTRIBUTION: Tropical America, with about 35 species. One species is sparingly cultivated in Fiji.

1. *Dichorisandra thyrsoiflora* Mikan, Del. Fl. Faun. Bras. t. 3. 1820; C.B. Clarke in DC. Monogr. Phan. 3: 278. 1881; J.W. Parham, Pl. Fiji Isl. ed. 2. 351. 1972.

Cultivated in Fiji, this plant is a coarse, scrambling herb to 2 m. high, with bright blue inner perianth segments. The only available collection was flowering in March.

TIPIFICATION: Based on an apparently cultivated plant in Brazil ("... prope Sebastianopolim, ... et prope Tocajam, ..."). The excellent plate could be taken as the type, although a type specimen may exist at w.

DISTRIBUTION: Brazil; cultivated elsewhere. Only one Fijian voucher has been seen, but the species is probably grown in other private gardens.

LOCAL NAME AND USE: *Blue ginger*. Ornamental.

AVAILABLE COLLECTION: VITI LEVU: REWA: Lami, in private garden, DA 16460.

ORDER RESTIONALES

This order has been variously treated by phylogenists; Takhtajan takes it to include the families Restionaceae, Centrolepidaceae, Flagellariaceae, and Hanguanaceae. The Flagellariaceae, long considered as composed of three genera, have more recently been divided into three unigeneric families. Of these families, the Hanguanaceae (Airy Shaw in Kew Bull. 18: 260. 1965) should probably be removed from the Restionales and the subclass Commelinidae to the alliance of the family Xanthorrhoeaceae (order Liliales, subclass Liliidae). The genera *Flagellaria* and *Joinvillea* are anatomically so distinct that they cannot remain joined in the same family (cf. Tomlinson in Metcalf, C.R. (ed.). *Anatomy of the Monocotyledons* 3: 69-82. 1969), although they seem correctly placed in the Commelinidae and perhaps in the order Restionales.

KEY TO FAMILIES OCCURRING IN FIJI

- High-climbing lianas with solid stems; leaves with sheathing bases closed or distally open, the blades rolled in bud, the midrib extended into a long, coiled tendril; perianth segments somewhat petaloid; ovules axile. 36. FLAGELLARIACEAE
- Reedlike herbs, the stems erect, hollow except at nodes; leaves with open sheaths, the blades conspicuously plicate in bud, without tendrils; perianth segments scarious or chartaceous; ovules pendulous. 37. JOINVILLEACEAE

FAMILY 36. FLAGELLARIACEAE

FLAGELLARIACEAE Dumort. Anal. Fam. Pl. 59, 60. 1829.

High-climbing lianas with solid stems, these often dichotomously branched, supported by leaf tendrils; leaves with tubular, closed or distally open, sheathing bases

articulated to indistinct petioles, the blades lanceolate, rolled in bud, the thickened midrib extended into a long, coiled tendril; inflorescence a terminal panicle, sometimes to 2 m. long, the young branches pale; flowers ♂, actinomorphic, small, sessile; perianth segments 6, imbricate in 2 series, somewhat petaloid, white or cream-white when young, free or short-connate basally, persistent in fruit; stamens 6, free, the anthers basifixed, 2-celled, opening by longitudinal introrse slits; ovary superior, 3-locular, each locule with a solitary, axile, orthotropous ovule; styles 3, appressed and erect in bud; fruit a subglobose drupe, indehiscent, the stigmas becoming spreading, the seeds 3 or fewer by abortion, with copious endosperm and a small embryo.

DISTRIBUTION: Four species in tropical Africa, tropical southeastern Asia, Malaysia, Micronesia, New Caledonia, and northern Australia, eastward to Samoa and Niue. Three species occur in Fiji. As noted above, the family is now restricted to a single genus.

1. *FLAGELLARIA* L. Sp. Pl. 333. 1753; Seem. Fl. Vit. 314, p. p. 1868; Backer in Fl. Males. I. 4: 246. 1951; Tomlinson & A.C. Sm. in Taxon 19: 888. 1970; A.C. Sm. in Allertonia 1: 341. 1978.

Characters of the family.

TYPE SPECIES: *Flagellaria indica* L., the only original species.

DISTRIBUTION: As of the family.

USEFUL TREATMENT OF GENUS: Smith, A.C. *Flagellaria*. Allertonia 1: 341-344. 1978.

Herbarium specimens of *Flagellaria* are sometimes difficult to place. It is desirable to have the basal portion of a mature leaf, with its sheath junction intact and with a few internodes of a mature stem.

KEY TO SPECIES

Sheath of mature leaves deeply cleft and V-shaped, sometimes dorsally obviously carinate, without a revolute flange; distal leaf blades of mature plants 50-75 cm. long and 6-11 cm. broad; mature stem 15-35 mm. in diameter toward apex, lacking a waxy bloom, sometimes conspicuously flattened and up to 50 mm. broad. 1. *F. neo-caledonica*

Sheath of mature leaves distally truncate or only very shallowly cleft, dorsally rounded.

Stem (5-) 12-28 mm. in diameter toward apex, typically with a conspicuous white waxy bloom; leaf sheaths in older leaves typically produced into a conspicuously revolute flange on all sides of stem; distal leaf blades of mature plants 40-80 cm. long and (2-) 5-10 cm. broad; mature panicle 60-200 cm. long, the peduncle obvious, 2-5 cm. long and 8-12 mm. in diameter; drupes 10-12 mm. long. 2. *F. gigantea*

Stem 3-10 mm. in diameter toward apex, lacking a waxy bloom (or with a light bloom rarely present on the distal 4 or 5 internodes only); leaf sheath appressed to stem at apex, not forming a revolute flange even in older leaves; distal leaf blades 15-35 cm. long and 1.5-3 cm. broad; mature panicle 15-50 cm. long, the peduncle none or short, to 2.5 cm. long and 2-6 mm. in diameter; drupes 6-10 mm. long. 3. *F. indica*

1. *Flagellaria neo-caledonica* Schlechter in Bot. Jahrb. 39: 27. 1906; A.C. Sm. in Allertonia 1: 342. fig. 4, A. 1978. FIGURE 68A & B.

In Fiji this species occurs from near sea level to about 250 m. in secondary forest or on the edges of mangrove swamps. It is a high-climbing liana with the stem

FIGURE 68. A & B, *Flagellaria neo-caledonica*; A, mature stem and leaf bases, with leaf tips and tendrils, × 1, from DA 16874; B, flower, with 2 perianth segments and 2 stamens removed, × 30, from DA 12999. C & D, *Flagellaria gigantea*; C, mature stem and leaf bases, with a leaf tip and tendril, × 1, from DA 16647; D, developing fruit, showing perianth segments, filaments, and stigmas, × 20, from MacDaniels 1153.





FIGURE 69. *Flagellaria gigantea*, from Smith 8929; distal portion of a stem, with leaves and an infructescence, being held in the forest of Namosi Province, Viti Levu.

sometimes conspicuously flattened but sometimes terete, and with a terminal inflorescence often exceeding 1 m. in length.

LECTOTYPIFICATION: Schlechter based the species on two of his own collections at B, presumably now destroyed. In 1978 I designated as the lectotype *Schlechter 15386* (K; ISOLECTOTYPE at BM), collected in November, 1902, in low hills at Ngoye, New Caledonia.

DISTRIBUTION: New Caledonia, Loyalty Islands, Solomon Islands, and Fiji. It is infrequent in Fiji, where no local names have been noted.

AVAILABLE COLLECTIONS: VITI LEVU: NAITASIRI: Toninaiwau, Tholo-i-suva, DA 16696, 16698. KANDAVU: Without further locality, DA 12999. VANUA LEVU: THAKAUNDROVE: Near Mbutha, Mbutha Bay, DA 16874. FIJI without further locality, U.S. Expl. Exped. (US 45313).

2. *Flagellaria gigantea* Hook. f. in Hook. Icon. Pl. **15**: t. 1429. 1883; Christophersen in Bishop Mus. Bull. **128**: 47. 1935; Yunker in op. cit. **178**: 31. 1943; J.W. Parham, Pl. Fiji Isl. 258. 1964, ed. 2. 351. 1972; Sykes in New Zealand Dept. Sci. Indust. Res. Bull. **200**: 232. 1970; B.E.V. Parham in New Zealand Dept. Sci. Indust. Res. Inform. Ser. **85**: 52. 1972; A.C. Sm. in Allertonia **1**: 344, fig. 4, B, C. 1978. FIGURES 68C & D, 69.

Flagellaria gigantea occurs in Fiji at elevations from near sea level to 900 m. in dense, thin, or open forest, in patches of forest in open country, and sometimes on the edges of mangrove swamps. It is a high-climbing liana with a terminal inflorescence up to 2 m. in length; the young inflorescence branches and perianth segments are white or cream-white, and the fruit is dull ivory-white. Flowering and fruiting specimens have been noted in most months.

LECTOTYPIFICATION: Hooker's original citation mentioned two collections from Fiji and one from Samoa. In 1978 I provided justification for designating as the lectotype *U.S. Expl. Exped.* (κ), from Fiji without further locality. Three *U.S. Expl. Exped.* specimens at US (45310, 45311, 45312) are presumably isolectotypes, and one of these is indicated as from Mbua Bay, Mbua Province, Vanua Levu, which may be considered the type locality.

DISTRIBUTION: Fiji, Samoa, and Niue. Although this is the most abundant species of *Flagellaria* in Fiji, because of its interest I cite all the known collections below. According to Christophersen and Sykes it is also frequent in Samoa and Niue, and it is probably the only species of the genus to be found in those areas. The species has been reported from New Ireland by Backer (in *Fl. Males. I.* 4: 248. 1951), but I am unable to document such an occurrence.

LOCAL NAMES AND USES: The Fijian names *holo* (Mba), *waulo levu* (Serua), *walaki* (Mathuata), and *ngalo* (Taveuni) have been noted. The stems are used in house building as a roof frame on which thatch is tied; when split the stems are used for binding house timbers and also in making baskets.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Vicinity of Nandarivatu, *Reay 12, Degener 14309*. SERUA: Thulanuku, vicinity of Ngaloa, *Degener 15122*. NAMOSI: Hills bordering Wainavindrau Creek, in vicinity of Wainimakutu, *Smith 8559*; hills east of Wainikoroiluva River, near Namuamua, *Smith 8929*. NAITASIRE: Tholo-i-suva, *DA 7573*; Toninaiwau, Tholo-i-suva, *DA 16647, 16648*; Central Road, *MacDaniels 1153, Tothill 907, s. n.*; Kalambo, *Tothill 909*. REWA: Mt. Korombamba, *Parks 20122, Gillespie 2319*. KANDAVU: Hills above Namalata and Ngaloa Bays, *Smith 173*. VANUA LEVU: MATHUATA: Seanggangga Plateau, in drainage of Korovuli River, vicinity of Natua, *Smith 6666*; Saivou, Seanggangga River, *DA 13444*. THAKAUNDROVE: Vicinity of Savusavu, *Bierhorst F210*. VANUA LEVU without further locality, *MacGillivray & Milne 259 bis*. TAVEUNI: Vicinity of Waivevo, *Gillespie 4804*; western slope between Somosomo and Wairiki, *Smith 753*. FIJI without further locality, *Howard 101, p.*

3. *Flagellaria indica* L. Sp. Pl. 333. 1753; Seem. in *Bonplandia* 9: 260. 1861, in op. cit. 10: 297. 1862, Viti, 443. 1862, Fl. Vit. 315. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 321. 1892; Backer in *Fl. Males. I.* 4: 246. fig. 1. 1951; J.W. Parham, Pl. Fiji Isl. 258. 1964, ed. 2. 351. 1972; A.C. Sm. in *Allertonia* 1: 344. fig. 4, D. 1978.

In Fiji this slender-stemmed *Flagellaria* occurs from near sea level to about 200 m., in dense, open, or dry forest. It is a high-climbing liana, the young inflorescence being white, the fruit at first green but becoming dull white at maturity. Flowering has been noted from November to January and fruiting from April to December.

TYPIIFICATION: Linnaeus gave prior references and noted: "*Habitat in Java, Malabar, Zeylona.*"

DISTRIBUTION: From tropical southeastern Asia throughout Malesia to Micronesia and northern Australia and eastward to Fiji. Although the species is sometimes reported to occur in "Polynesia," I have seen no authenticated records of it from east of Fiji. The tropical African species of this alliance is presumably *F. guineensis* Schumacher (cf. Hepper, Fl. W. Trop. Afr. ed. 2. 3: 51. fig. 333. 1968).

LOCAL NAMES AND USES: Recorded Fijian names are *waulo*, *walaki*, *wa sila*, *nggalo*, and *vere*. The stems are sometimes used to make a frame to support the grass thatch of houses, and when split the stems are used to make baskets. Although his identification of the species was correct, Seemann in the references listed above indicated local names and uses that are applicable to the grass *Saccharum edule*.



AVAILABLE COLLECTIONS: VITI LEVU: SERUA: Hills west of Waivunu Creek, between Ngaloa and Korovou, *Smith* 9323; Vatuivilakia, vicinity of Ngaloa, *Degener* 15143; hills between Waininggere and Waisee Creeks, between Ngaloa and Wainiyambia, *Smith* 9677. NAITASIRE: Toninaiwau, Tholo-isuva, *DA* 16649; Central Road, *Tothill* 541, 910; Tamavua, *Gillespie* 2179. REWA: Naikorokoro Creek, *Meebold* 21950; Mt. Korombamba, *DA* 16505. "VITI LEVU and TAVEUNI:" *Seemann* 644. OVALAU: Wainiloka, *DA* 1337; Port Kinnaird, *Storck* 910. VANUA LEVU: MBUA: Lower Wainunu River Valley, *Smith* 1714. AVEA (Exploring Isles): *Bryan* 582. FIJI without further locality, *Howard* 101, *p. p.*

FAMILY 37. JOINVILLEACEAE

JOINVILLEACEAE Tomlinson & A.C. Sm. in *Taxon* **19**: 888. 1970.

Rhizomatous, perennial, reedlike herbs, the stems slender, erect, unbranched, hollow except at nodes; leaves with tubular, open, sheathing bases, the mouths of sheaths with diminutive ligules, the blades abruptly narrowed at base and articulated to sheaths, linear-lanceolate, conspicuously plicate; inflorescence a terminal panicle, sometimes to 1 m. long; flowers ♂, actinomorphic, small, sessile; perianth segments 6, imbricate in 2 series, scarious or chartaceous, free or slightly adnate proximally, persistent and spreading in fruit; stamens 6, free or slightly adnate to perianth segments proximally, the anthers basifixed, bilocular, sagittate at base, exerted at anthesis, opening by longitudinal lateral slits; ovary superior, 3-locular, each locule with a solitary, pendulous, orthotropous ovule; styles 3, free or slightly connate at base, the stigmas becoming spreading and plumose, inconspicuously subpersistent or caducous; fruit a subglobose to triquetrous drupe, indehiscent, the seeds 3 or fewer by abortion, with copious endosperm and a minute embryo.

DISTRIBUTION: Two species (with four and two subspecies respectively) from western Malasia eastward to Samoa and Hawaii, but absent from southern and eastern Indonesia, New Guinea, and Australia. One species occurs in Fiji.

USEFUL TREATMENTS OF FAMILY: Tomlinson, P.B., & A.C. Smith. Joinvilleaceae, a new family of monocotyledons. *Taxon* **19**: 887-889. 1970. Lee, D.W., Y.K. Pin, & L.F. Yew. Serological evidence on the distinctness of the monocotyledonous families Flagellariaceae, Hanguanaceae and Joinvilleaceae. *Bot. J. Linn. Soc.* **70**: 77-81. 1975.

1. JOINVILLEA Gaud. Voy. Bonite, Vaillant, *Bot. Atlas*, *pl.* 39, 40, nom. illeg. 1841; Gaud. ex Brongn. & Gris in *Bull. Soc. Bot. France* **8**: 268. 1861; Backer in *Fl. Males. I.* **4**: 245. 1951; Newell in *J. Arnold Arb.* **50**: 543. 1969; Tomlinson & A.C. Sm. in *Taxon* **19**: 888. 1970.

Flagellaria subgen. *Chortodes* Hook. f. in Hook. J. *Bot. Kew Gard. Misc.* **7**: 200. 1855.

Flagellaria sensu Seem. *Fl. Vit.* **314**, *p. p.* 1868.

Characters of the family.

LECTOTYPE SPECIES: Although in 1967 Newell and Stone indicated *Joinvillea plicata* (Hook. f.) Newell & Stone as the type species, this error was corrected in 1969 by Newell, who selected *J. elegans* Brongn. & Gris (a synonym of *J. plicata*) as the appropriate lectotype species. In *Fl. Haw. Fam.* 53a. (March 31) 1973, O. & I. Degener disagreed with this selection and proposed *J. gaudichaudiana* Brongn. & Gris as the lectotype species. Newell considers *J. gaudichaudiana* a synonym of *J. ascendens* Brongn. & Gris. Personally I see no reason to reject Newell's choice of *J. elegans*.

DISTRIBUTION: As of the family.

FIGURE 70. *Joinvillea plicata* subsp. *plicata*; A, apical portion of stem, with terminal panicle in fruit, $\times 1/4$; B, flower, with one stamen removed, $\times 20$; C, fruits on terminal portion of panicle branch, $\times 4$; D, fruit, showing persistent perianth segments, $\times 10$; A from *Smith* 4182, B from *DA* 18139, C & D from *Smith* 1642.

USEFUL TREATMENTS OF GENUS: Newell, T.K., & B.C. Stone. *Flagellaria* (Chortodes) plicata Hooker fil. is a *Joinvillea*. *Taxon* 16: 192-194. 1967. Newell, T.K. A study of the genus *Joinvillea* (Flagellariaceae). *J. Arnold Arb.* 50: 527-555. 1969.

1. *Joinvillea plicata* (Hook. f.) Newell & Stone subsp. ***plicata***; Newell in *J. Arnold Arb.* 50: 551. fig. 4, E-H; fig. 5, E-G. 1969; *J. W. Parham*, *Pl. Fiji Isl.* ed. 2. 352. 1972. FIGURE 70.

Flagellaria plicata Hook. f. in Hook. J. Bot. Kew Gard. Misc. 7: 200. pl. VIII. 1855.

Joinvillea elegans Gaud. Voy. Bonite, Vaillant, Bot. Atlas, pl. 39, 40, fig. 7-26, nom. illeg. 1841; Brongn. & Gris in Bull. Soc. Bot. France 8: 268. 1861; Seem. in Bonplandia 9: 260. 1861, Viti, 443. 1862; Drake, Ill. Fl. Ins. Mar. Pac. 321. 1892.

Flagellaria elegans Seem. Fl. Vit. 315. 1868; *J. W. Parham*, *Pl. Fiji Isl.* 258. 1964.

Joinvillea plicata Newell & Stone in *Taxon* 16: 193. 1967.

The single species of *Joinvillea* in Fiji occurs from near sea level to 1,195 m., in dense or secondary forest, roadside thickets, ridge forest, and crest thickets. It is a coarse, erect herb found in large clumps 1-5 m. high and is often locally frequent. The perianth segments are pale green or dull white, the stigmas are white, and the fruit at maturity varies from reddish orange to deep brown. Flowers and fruits may be expected throughout the year.

LECTOTYPIFICATION AND NOMENCLATURE: *Flagellaria plicata* was based on two collections, of which Newell in 1969 chose *MacGillivray* 770 (κ) as the lectotype; the specimen was collected in October, 1853, at Assumption Bay, Ile des Pins, New Caledonia. *Joinvillea elegans* was well illustrated by Gaudichaud in 1841 but was not validly published until 1861, when Brongniart and Gris described it without mentioning an actual specimen. Presumably their description was based on Gaudichaud's illustrations, but no known specimen supports these and consequently the type locality is not known.

DISTRIBUTION: Solomon Islands, New Caledonia including Ile des Pins, New Hebrides, and Fiji. More than 30 collections are available from Fiji. A second subspecies, *Joinvillea plicata* subsp. *bryanii* (Christophersen) Newell, occurs in Samoa.

LOCAL NAME AND USE: *Ngasau ni veikau*. In Serua the roots are said to be used as a poultice on wounds.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Summit of Mt. Koroyanitu, Mt. Evans Range, *Smith* 4182; vicinity of Nandarivatu, *Newell* 234; Vuninatambua, Navai, *Degener* 14876; slopes of Mt. Tomanivi, *DA* 7084. MBA or NAITASIRI: Between Nandarivatu and Nasonggo, *Reay* 34. SERUA: Hills west of Waiyunu Creek, between Ngaloa and Korovou, *Smith* 9247; vicinity of Ngaloa, *Degener* 15139, *Newell* 227-233 incl. NAMOSI: Hills east of Navua River, *Greenwood* 1008. NAITASIRI: Track between Matawailevu and Vunindawa, *DA* 18139; Sawani-Serea road, *Newell* 226. VITI LEVU without further locality, *Seemann* 645. VANUA LEVU: MBUA: Navotuvotu, summit of Mt. Seatura, *Smith* 1642. MATHUATA: Ndreketi, *DA* 13456; Mt. Ndelaikoro, *DA* 12838. THAKAUNDROVE: Eastern drainage of Yanawai River, *Degener & Ordenez* 14063; Mt. Mbatini, *Smith* 655. TAVEUNI: Above Somosomo, *Gillespie* 4820.

ORDER POALES
FAMILY 38. POACEAE
BY JOHN W. PARHAM

(Formerly of the Department of Agriculture, Suva, and the Queensland
Herbarium, Brisbane)

POACEAE Barnhart in Bull. Torrey Bot. Club 22: 7. 1895.

Gramineae Juss. Gen. Pl. 28. 1789. Nom. alt.

Annuals or perennials, herbaceous, rarely woody or tree-like; stems erect, ascend-

ing, prostrate, or creeping, often tufted, terete, jointed and hollow, with solid nodes, the perennials producing sterile shoots and flowering culms, the annuals producing flowering culms only; leaves elongate, distichous, solitary at nodes or crowded at base of stem, with sheaths encircling stem and with a ligule at junction of blade and sheath, the ligule either membranaceous or composed of a fringe of hairs; inflorescence a spike, raceme, or panicle, bearing sessile or pedicellate spikelets of 1–many florets; flowers small, usually ♂; fruit a seedlike grain (caryopsis).

DISTRIBUTION: Usually considered to include about 620 genera and at least 10,000 species distributed throughout the world. The grasses comprise one of the largest families of flowering plants and include many species of great economic importance. In Fiji raw sugar manufactured from sugarcane (*Saccharum officinarum*) is one of the major exports. Other locally important grasses are rice (*Oryza sativa*), grain and broom sorghums (*Sorghum* spp.), corn (*Zea mays*), a number of pasture grasses, bamboos (*Bambusa vulgaris*; *Schizostachyum glaucifolium*), reeds (*Miscanthus floridulus*; *Arundo donax*) used by the inhabitants in the building of houses, fences, rafts, etc., and the leaves of the sugarcane, also used for some building purposes.

USEFUL TREATMENTS OF FAMILY: Summerhayes, V.S., & C.E. Hubbard. The grasses of the Fiji Islands. Kew Bull. 1927: 18–44. 1927, in op. cit. 1930: 252–265. 1930. Parham, J.W. The grasses of Fiji. Dept. Agr. Fiji Bull. 30: i–x. 1–166, pl. I–XII, fig. 1–61. 1956. Bor, N.L. The Grasses of Burma, Ceylon, India and Pakistan (excluding Bambuseae). i–xviii. 1–767. 1960. Henty, E.E. A manual of the grasses of New Guinea. Dept. Forests Bot. Bull. (Lae) I: 1–215. 1969. Hubbard, C.E., in Hutchinson, J. The Families of Flowering Plants, ed. 3, 871–901. 1973.

Seemann (Fl. Vit. 320–327. 1868, 1873) recorded 16 species of grasses from Fiji, of which eleven were considered to be indigenous. He did not discuss any endemic species, the first such to be described being *Isachne vitiensis* Rendle, based on specimens collected by Lilian Gibbs in 1907. The two papers by Summerhayes and Hubbard are particularly significant, as they record a further 44 species, of which six were considered indigenous (two of them being endemic) and 38 were said to be introduced. Summerhayes and Hubbard based their review mainly on the collections made by William Greenwood and those of Dr. and Mrs. J.D. Tothill, who collected widely in Fiji and especially in the Lau Group. Since the work of Summerhayes and Hubbard an additional six endemic species have been described by J.R. Swallen, five of them being species of *Garnotia*.

The publication, over the years, of lists containing misidentifications and records of species that have not become naturalized has made it difficult to assess accurately the number of species of grasses now known from Fiji. In the present treatment 60 genera and 128 species are included; of these species 32 are believed to be indigenous (nine of them being endemic) and 96 introduced, now being either naturalized or cultivated. Of the 96 introduced grasses, 81 have been recorded since the turn of the century. Every attempt has been made to account for all the names that have been used in publications listing or discussing the Fijian grass flora, and it will be noted that there are a number of names representing taxa that are not, in fact, to be found in Fiji.

ARTIFICIAL KEY TO GENERA

Culms woody, bamboolike.

Internodes usually hollow, the nodes solid; leaf blades flat, many-nerved, often with transverse veinlets, usually with a petiolelike base joined with sheath; spikelets bisexual; culms 3–15 m. high. Culms up to 15 m. high, 3.5–6 cm. in diameter; spikelets 1-flowered, in long, narrow spikes.

1. *Schizostachyum*

- Culms 3–15 m. high, either about 2.5 cm. or 10–12.5 cm. in diameter; panicles often leafless, the spikelets many-flowered, the palea 2-keeled. 2. *Bambusa*
- Internodes and culms sometimes suggesting those of true bamboos but the culms only 40–120 cm. high, terete, ribbed, dichotomously branched, glabrous, glaucous, 2–5 mm. in diameter.
- Leaf blades flat, linear-lanceolate, 4–9 cm. long, 2–4 mm. wide; inflorescence a terminal, open panicle with distantly placed, alternating, ascending branches. 39. *Ancistrachne*
- Leaf blades 6–20 cm. long, 0.5–1.5 mm. wide; racemes rather distant, overlapping; spikelets with terete awns 10–15 mm. long. 18. *Aristida*
- Culms not bamboolike.
- Spikelets all bisexual, or sometimes with ♂ or barren and ♀ spikelets mixed in the same inflorescence, or if unisexual with the lemma of the fertile floret indurated.
- Inflorescence a plumelike panicle; spikelets silky.
- Grasses tall, reedlike, more than 1.5 m. high.
- Plant a reed 1.8–5.4 m. high, with large, plumose panicles. 7. *Arundo*
- Plant a reed 1.8–3.6 m. high, with small, plumose panicles. 43. *Miscanthus*
- Plant the commonly cultivated sugarcane, 3–3.6 m. high, with plumose panicles; stem 3.7–5 cm. in diameter. 46. *Saccharum (officinarum)*
- Plant sugarcanelike, 3–3.5 m. high, the stem 2.5–3.7 cm. in diameter; usually found in swampy places.
- Panicle opening fully. 44. *Erianthus*
- Panicle not opening at all. 46. *Saccharum (edule)*
- Grasses small, less than 1.5 m. high.
- Inflorescence narrow, white; arising from a strong rhizome. 42. *Imperata*
- Inflorescence a rose-pink panicle; delicate grass. 40. *Rhynchelytrum*
- Inflorescence a solitary spike or spike-like panicle.
- Awns present.
- Panicle leafy; awn dark reddish brown, bent, 5–10 cm. long. 54. *Heteropogon*
- Panicle not leafy.
- Spikelets usually solitary at each node of axis of spike, slightly awned. 5. *Triticum*
- Spikelets more than one at each node of axis of spike; awn 10–15 cm. long. 6. *Hordeum*
- Awns absent; bristles present.
- Spikelets subtended by a bristle or bristles. 32. *Setaria*
- Spikelets enclosed by bristles, these not united except at base. 37. *Pennisetum*
- Spikelets enclosed by bristles fused for some distance (forming an involucre). 36. *Cenchrus*
- Awns and bristles present, the bristles brown to cream-colored, about 3 mm. long, the awns reddish brown, about 6 mm. long. 45. *Polytrias*
- Awns and bristles absent.
- Spikelets 1-flowered; erect, coarse grass, the rhizome creeping extensively; leaf blades involute; panicle 10–20 cm. long. 16. *Ammophila*
- Spikelets 1-flowered, pedicellate in open or contracted, spike-like panicles, rarely racemose. 11. *Sporobolus*
- Spikelets arranged on alternate sides, embedded in the flattened rachis of the spike. 14. *Lepturus*
- Spikelets embedded in one side of the flattened rachis of the spike. 34. *Stenotaphrum*
- Spikelets oblong, densely crowded; rachis of spikelet not flattened. 38. *Sacciolepis*
- Spikelets on a spike almost completely enclosed in a leafy bract; grass of sandy coastal areas. 35. *Thuarea*
- Spikelets laterally compressed, short-stalked, appressed against a slender rachis, the lower glume absent, the upper glume mucronate; small, creeping grass; leaf blades very narrow, 1.2–2 cm. long. 19. *Zoysia*
- Inflorescence of two to many racemes or spikes.
- Spikelets with transverse ridges, awned; racemes paired, terminal. 48. *Ischaemum (rugosum)*
- Spikelets not ridged; racemes paired, terminal, sometimes a third one present.
- Awn more than 12 mm. long. 56. *Dichanthium*
- Awn less than 12 mm. long. 48. *Ischaemum*
- Spikelets flattened, arranged in two rows along one side of rachis; awns absent. 27. *Paspalum*
- Spikelets in two rows, not flattened; awns absent. 26. *Axonopus*
- Spikelets not arranged in rows; awns absent. 23. *Digitaria*
- Inflorescence a succession of racemes along main axis.
- Spikelets subtended by a bristle. 32. *Setaria (barbata)*
- Spikelets dense, not subtended by a bristle, borne on one side of rachis; grasses of wet areas. 28. *Echinochloa*
- Spikelets borne right to base of raceme; rachis fragile, not one-sided. 47. *Microstegium*

- Spikelets not borne to base of raceme.
- All spikelets more or less alike; awn 12 mm. or more long. 56. *Dichanthium (annulatum)*
- All spikelets not alike; awn less than 12 mm. long. 57. *Bothriochloa*
- Spikelets not dense, borne in two rows; creeping, shade-loving grasses. 30. *Oplismenus*
- Spikelets arranged in two rows (sometimes more) along rachis; awns and bristles absent.
- Inflorescence with rounded and flattened spikelets. 27. *Paspalum*
- Inflorescence with spikelets not flattened. 25. *Bracharia*
- Spikelets not arranged in two rows along rachis; awns and bristles absent; leaf blades narrow; inflorescence in many whorls of purple-tinged racemes. 50. *Vetiveria*
- Spikelets borne on racemes that have 3-5 digitate or subdigitate branches.
- Spikes with stout spikelets.
- Termination of spike a spikelet. 9. *Eleusine*
- Termination of spike a projection of the rachis. 10. *Dactyloctenium*
- Spikes with small, delicate spikelets.
- Awns present. 13. *Chloris*
- Awns absent. 12. *Cynodon*
- Inflorescence a panicle but not plumelike nor with silky spikelets.
- Panicle leafy with spathes and spatheoles.
- Grasses aromatic. 52. *Cymbopogon*
- Grasses nonaromatic.
- Racemes paired. 53. *Hyparrhenia*
- Racemes single.
- Awns 5-10 cm. long. 54. *Heteropogon*
- Awns less than 5 cm. long. 55. *Themeda*
- Panicle not leafy.
- Spikelets of many overlapping flowers. 8. *Eragrostis*
- Spikelets not with overlapping flowers.
- Awns present. 51. *Chrysopogon*
- Awns absent; leaves with odor of molasses. 29. *Melinis*
- Panicle open to compressed, with several to many ascending to spreading branches and branchlets.
- Branches of panicle compressed.
- Panicle with upper lemma and palea indurated, closed at maturity. 41. *Isachne*
- Panicle with branches 1-2.5 cm. long; spikelets black, sparse; leaf blades narrowed to a short petiolelike base (probably restricted to Vanua Levu hills). 22. *Leptaspis*
- Panicle with distantly placed, alternate, ascending branches up to 4 cm. long; culms bamboo-like, terete, ribbed, dichotomously branched, 2-5 mm. in diameter. 39. *Ancistrachne*
- Panicle with racemes of many pairs of laterally compressed, purple-tinged spikelets, the primary branches in whorls of 6-29. 50. *Vetiveria*
- Panicle sometimes open; spikelets in pairs, one sessile and ♀ and one ♂ or neuter; primary branches of panicle whorled, at least at a few lower nodes; awns, if present, often deciduous. 49. *Sorghum*
- Panicle composed of rather distant, overlapping, few-flowered racemes; spikelets stalked, the glumes mucronate, the awns terete, 10-15 mm. long. 18. *Aristida*
- Branches of panicle open.
- Panicle with numerous branches; upper glume as long as the spikelet. 31. *Panicum*
- Panicle with numerous branches; leaf blades broad, many-nerved, with transverse veins; shade-loving grass; common. 3. *Centosteca*
- Panicle with few branches, open at first but appressed at maturity, one-sided; leaf blades narrow, lacking transverse veins. 4. *Dactylis*
- Panicle with few to many branches, these ascending.
- Spikelets disarticulating below glumes and falling entire; spikelets usually fine-awned; native grasses, not common. 17. *Garnottia*
- Spikelets disarticulating above glumes, leaving very small, persistent glumes; spikelets slender-awned. 20. *Microlaena*
- Panicle terminal, with several ascending branches; lower glume and lowest internodes of rachilla forming a swollen callus at base of spikelet; upper lemma mucronate or short-awned. 24. *Eriochloa*
- Panicle with few branches, more or less open; spikelets laterally much compressed; creeping, shade-loving grasses. 33. *Cyrtococcum*
- Panicle with few branches, these few-flowered, with large, 2-flowered, nodding spikelets; glumes almost as long as spikelet, the lemmas glabrous, with poorly developed awns. 15. *Avena*

- Panicle with numerous ascending branches; spikelets large, bisexual; glumes present but much reduced, the fertile lemma shorter than the sterile, sometimes awned. . . . 21. *Oryza*
- Panicle with few to many branches; sterile lemma larger and longer than fertile lemma, enclosing it, awned. 20. *Microlaena*
- Spikelets unisexual, the ♂ and ♀ borne on the same plant (monoecious), the ♀ below, the ♂ above in the same inflorescence or in separate inflorescences; glumes indurate; fertile lemma and palea hyaline or membranaceous, the sterile lemma like the fertile in texture.
- Pistillate spikelets sunken in recesses in thickened joints of rachis; inflorescence of solitary or digitate racemes; large grass 3–3.5 m. high. 60. *Tripsacum*
- Pistillate spikelets borne on bony, beadlike involucre; grass of damp places, 1–2 m. high, with broad leaf blades. 59. *Coix*
- Pistillate spikelets in axillary, sheathed cobs; ♂ spikelets in large, terminal panicles. 58. *Zea*

The preceding key is artificial, but the numerical sequence of genera follows that of Hubbard in the two most recent editions of Hutchinson's *The Families of Flowering Plants*, to which the reader requiring more technical data is referred. Hubbard recognizes some 27 tribes, of which 18 are represented in Fiji. The following synopsis indicates the sequence of tribes and genera utilized in the present treatment.

- | | | |
|---------------------------|-------------------------|--------------------------|
| Tribe 1. Bambuseae | 17. <i>Garnotia</i> | 37. <i>Pennisetum</i> |
| 1. <i>Schizostachyum</i> | Tribe 14. Stipeae | 38. <i>Sacciolepis</i> |
| 2. <i>Bambusa</i> | 18. <i>Aristida</i> | 39. <i>Ancistrachne</i> |
| Tribe 3. Festuceae | Tribe 15. Zoysieae | 40. <i>Rhynchelytrum</i> |
| 3. <i>Centosteca</i> | 19. <i>Zoysia</i> | 41. <i>Isachne</i> |
| 4. <i>Dactylis</i> | Tribe 17. Phalarideae | Tribe 26. Andropogoneae |
| Tribe 4. Hordeae | 20. <i>Microlaena</i> | 42. <i>Imperata</i> |
| 5. <i>Triticum</i> | Tribe 18. Oryzeae | 43. <i>Miscanthus</i> |
| 6. <i>Hordeum</i> | 21. <i>Oryza</i> | 44. <i>Erianthus</i> |
| Tribe 6. Arundineae | Tribe 21. Phareae | 45. <i>Polytrias</i> |
| 7. <i>Arundo</i> | 22. <i>Leptaspis</i> | 46. <i>Saccharum</i> |
| Tribe 7. Eragrosteae | Tribe 25. Paniceae | 47. <i>Microstegium</i> |
| 8. <i>Eragrostis</i> | 23. <i>Digitaria</i> | 48. <i>Ischaemum</i> |
| 9. <i>Eleusine</i> | 24. <i>Eriochloa</i> | 49. <i>Sorghum</i> |
| 10. <i>Dactyloctenium</i> | 25. <i>Brachiaria</i> | 50. <i>Vetiveria</i> |
| Tribe 8. Sporoboleae | 26. <i>Axonopus</i> | 51. <i>Chrysopogon</i> |
| 11. <i>Sporobolus</i> | 27. <i>Paspalum</i> | 52. <i>Cymbopogon</i> |
| Tribe 9. Chlorideae | 28. <i>Echinochloa</i> | 53. <i>Hyparrhenia</i> |
| 12. <i>Cynodon</i> | 29. <i>Melinis</i> | 54. <i>Heteropogon</i> |
| 13. <i>Chloris</i> | 30. <i>Oplismenus</i> | 55. <i>Themeda</i> |
| Tribe 11. Leptureae | 31. <i>Panicum</i> | 56. <i>Dichanthium</i> |
| 14. <i>Lepturus</i> | 32. <i>Setaria</i> | 57. <i>Bothriochloa</i> |
| Tribe 12. Aveneae | 33. <i>Cyrtococcum</i> | Tribe 27. Maydeae |
| 15. <i>Avena</i> | 34. <i>Stenotaphrum</i> | 58. <i>Zea</i> |
| Tribe 13. Agrostae | 35. <i>Thuarea</i> | 59. <i>Coix</i> |
| 16. <i>Ammophila</i> | 36. <i>Cenchrus</i> | 60. <i>Tripsacum</i> |

1. SCHIZOSTACHYUM Nees, Agrost. Brasil. 535. 1829; Seem. Fl. Vit. 323. 1868; E. G. Camus, Bambusées, 171. 1913.

Large bamboos, the culms up to 15 m. high, 3.5–6 cm. in diameter; spikelets 1-flowered, in long, narrow spikes; palea lacking a keel and resembling lemmas.

TYPE SPECIES: *Schizostachyum blumii* Nees (ING).

DISTRIBUTION: About 35 species are recognized, extending from China and Korea to Burma, Malesia, and into the Pacific. Only one species is known from Fiji, this being considered indigenous.

1. *Schizostachyum glaucifolium* (Rupr.) Munro, Monogr. Bambus. 137. 1866; Seem. Fl. Vit. 323. 1868, 434. 1873; Munro in Trans. Linn. Soc. 26: 150. 1868; Summerhayes & Hubbard in Kew Bull. 1927: 44. 1927, in op. cit. 1930: 264.

1930; J. W. Parham in Dept. Agr. Fiji Bull. 30: 21. 1956, Pl. Fiji Isl. 309. 1964, ed. 2. 410. 1972.

Bambusa glaucifolia Rupr. in Acta Acad. Sci. Imp. Petrop. 147. 1839.

Bambusa sp. Seem. in Bonplandia 9: 261. 1861, Viti, 444. 1862.

Culms caespitose, up to 15 m. high, 3.5–6 cm. in diameter, with slender branches above approximately the tenth node, these 60–120 cm. long; leaf blades linear-lanceolate, glabrous, acuminate, the margins serrulate, the midrib prominent on lower surface.

TIPIFICATION: Based on material from the Pacific Islands, but I have not noted a suitable lectotypification.

DISTRIBUTION: Reported from Hawaii, Tahiti, and Samoa on the basis of U.S. Exploring Expedition specimens, and from the Marquesas (Kyber). It was first collected in Fiji by Seemann in 1860, recorded in *Flora Vitiensis* and by Munro also in 1868. Locally it is moderately common along the banks of rivers and streams, in thickets on hillsides, and in comparatively undisturbed forest from near sea level to more than 900 m.

LOCAL NAMES AND USE: *Mbitu* (applied generally to bamboos), *mbitu ndina* ("true" or indigenous bamboo); *mbitu kau* (bush bamboo); *mbitu ni Viti*. Although it is occasionally used in house-building, this apparently indigenous bamboo is not now as common or as widely used as the larger, naturalized, and now very common *Bambusa vulgaris*.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Nandala, near Navai, DA 11122. NAITASIRI: Vicinity of Viria, Meebold 17088; Sawani-Serea road, DA 11301; Lomaivuna, DA 17315. REWA: Wainimbokasi, DA 819. VITI LEVU without further locality, Seemann 694. OVALAU: Hills east of Lovoni Valley, Smith 7554. MOALA: Bryan 319.

2. *BAMBUSA* Retz. corr. Schreber, Gen. Pl. 236. 1789; Benth. & Hook. f. in Munro, Monogr. Bambus. iii, 1210. 1866. Nom. cons.

Bamboos with culms 2–15 m. high and 1–12.5 cm. in diameter; panicles often leafless; spikelets many-flowered, the palea 2-keeled.

TYPE SPECIES: *Bambos arundinacea* Retz. (ING).

DISTRIBUTION: About 70 tropical and subtropical species are known from Asia, Africa, and America. Some species are widely cultivated and naturalized. Two species, both of them introduced and naturalized, occur in Fiji.

KEY TO SPECIES

Culms up to 15 m. high, 10–12.5 cm. in diameter, green, yellow, or yellow with green vertical stripes; leaf blades up to 3.5 cm. broad. 1. *B. vulgaris*
Culms 2–4.5 m. high, 1–2 cm. in diameter, dark green; leaf blades up to 1.8 cm. broad. . . . 2. *B. multiplex*

1. *Bambusa vulgaris* Schrader ex Wendl. Collect. Pl. 2: 26. t. 47. 1808; Thurston, Cat. Trees, Shrubs and Foliage Pl. 17. 1886; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 20: 15. 1949, in Proc. 7th Pacific Sci. Congr. 5: 223. 1953; J. W. Parham in Dept. Agr. Fiji Bull. 30: 20. 1956, Pl. Fiji Isl. 300. 1964, ed. 2. 396. 1972.

Bambusa sieberi Griseb. Fl. Brit. W. Ind. 528. 1864.

Culms caespitose, with numerous slender branches 3–4.5 m. long; leaf blades linear-lanceolate, glabrous, acuminate, 20–25 cm. long, the margins serrulate, the midrib prominent on lower surface.

TIPIFICATION: The original protologue indicates: "Das Vaterland: Indien."

DISTRIBUTION: A widely distributed species, first listed as occurring in Fiji in J. B. Thurston's list of plant introductions, and first recorded as being naturalized by

B. E. V. Parham in 1949. It is now the most common bamboo in Fiji, widespread along river banks and on hillsides from sea level up to 1,000 m. altitude. Nevertheless, herbarium specimens have only infrequently been prepared.

LOCAL NAMES AND USES: *Mbitu ni vavalangi* (i. e. European bamboo); *common bamboo*. It is widely used in the construction of rafts for the transport of bananas and other produce, and is also much used in the construction of houses and fences. *Bambusa vulgaris*, before polythene tubes became readily available, was used for pots for seedlings. Its culms are split into strips and plaited for bamboo walls, used widely for interior decoration ("feature walls"), and have been noted in use as pipelines to carry water from streams into villages. The shoots are reported to be sometimes eaten.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Vicinity of Nalotawa, eastern base of Mt. Evans Range, *Smith 4314*; Nandala, near Navai, *DA 11124*. SERUA: Vicinity of Nakavu, *Parks 20382*. NAITASIRI: Nanduna, *DA 4022*. VITI LEVU without further locality, *DA 3897*. VANUA LEVU: THAKAUNDROVE: Vatorova, *Howard 168*.

2. ***Bambusa multiplex*** (Lour.) Raeuschel ex J. A. & J. H. Schultes, Syst. Veg. (L. ed. 16) 7 (2): 1350. 1830; J. W. Parham, Pl. Fiji Isl. ed. 2. 396. 1972.

Arundo multiplex Lour. Fl. Cochinch. 58. 1790.

Bambusa nana Roxb. Hort. Beng. 25, nom. nud. 1814, Fl. Ind. ed. 2. 2: 199. 1832; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 20: 15. 1949; J. W. Parham in Dept. Agr. Fiji Bull. 30: 20. 1956, Pl. Fiji Isl. 300. 1964.

Culms caespitose, with slender branches 1.5–1.8 m. long; leaf blades linear-lanceolate, glabrous to minutely hairy, acuminate, 4–10 cm. long; inflorescences spikeate, 20–40 cm. long; spikelets 10–25 mm. long.

TIPIFICATION: Loureiro based his species on material collected in the northern part of Indochina. *Bambusa nana* is typified by a collection from China.

DISTRIBUTION: Distributed fairly widely as an ornamental. It is common in Fiji as a cultivated plant and, in some places, as an escape, even though it is seldom collected. There is no record of the date of its introduction into Fiji. Flowers have been noted in April, August, November, and December.

LOCAL NAMES AND USES: *Dwarf bamboo*; *Chinese bamboo*. As an ornamental, this species makes a good hedge when it is clipped, and it may be used as a wind-break. The culms are sometimes used as stakes, and the young shoots are reported to be edible.

AVAILABLE COLLECTIONS: VITI LEVU: RA: Demonstration Farm, Ndombuilevu, *DA 9545, 11111*. NAITASIRI: Wainiveimbalambala Creek, *DA 3553*. FIJI without further locality, *DA 3532*.

PLANT INTRODUCTIONS OF BAMBOOS

The following bamboos were introduced from the U. S. Department of Agriculture on Oct. 9, 1957, and planted at the Cocoa Station, Nanduruloulou, Naitasiri Province, Viti Levu. The species marked with an asterisk are reported to have survived. (FDA = Fiji Department of Agriculture introduction number.)

FDA 15060. *Bambusa ventricosa* McClure

*FDA 15061. *Bambusa tuldoidea* Munro

FDA 15062. *Bambusa textilis* McClure

FDA 15063. *Bambusa malingensis* McClure

FDA 15064. *Bambusa dissimulata* McClure

FDA 15065. *Bambusa pervariabilis* McClure

FDA 15066. *Bambusa tulda* Munro

FDA 15067. *Gigantochloa verticillata* (Willd.) Munro

*FDA 15068. *Gigantochloa apus* (Roemer & Schultes) Kurz ex Munro

FDA 15069. *Melocanna baccifera* (Roxb.) Kurz

FDA 15070. *Ochlandra travanica* Benth. ex Gamble

Two clumps of *Dendrocalamus giganteus* Munro have been established on the bank of the Rewa River just above the old sugar mill site at Nausori (Tailevu Province, Viti Levu). Earlier reports of *Gigantochloa aspera* (Roemer & Schultes) Kurz and *Bambusa siamensis* Kurz (B. E. V. Parham in Agr. J. Dept. Agr. Fiji 20: 26. 1949; J. W. Parham in Dept. Agr. Fiji Bull. 30: 20. 1956) have not been substantiated with specimens and are best ignored.

3. CENTOSTECA Desv. in Nouv. Bull. Sci. Soc. Philom. Paris 2: 189. 1810.

Centosteca Desv. ex Seem. Fl. Vit. 322. 1868.

Leaf blades flat, broadly lanceolate or ovate-lanceolate, with numerous transverse veins; inflorescence an open panicle; spikelets stalked, 1–3-flowered, the lemmas lacking an awn.

TYPE SPECIES: *Centosteca lappacea* (L.) Desv. (*Cenchrus lappaceus* L.) (ING).

DISTRIBUTION: Tropical Africa, Asia, and into Polynesia. Four species are known, but only one, *Centosteca lappacea*, has been noted in Fiji, where it is considered to be indigenous.

It has recently been pointed out by T. R. Soderstrom and H. F. Decker (*Calderonella*, a new genus of grasses and its relationship to the centostecoid genera. Ann. Missouri Bot. Gard. 60: 427–441. 1973) that the generic name was originally published as *Centosteca* by Desvaux. This should be used, therefore, instead of the long-accepted misspelling *Centothecha*.

1. *Centosteca lappacea* (L.) Desv. in Nouv. Bull. Sci. Soc. Philom. Paris 2: 189. 1810.

Cenchrus lappaceus L. Sp. Pl. ed. 2. 1488. 1763.

Centosteca lappacea Desv. ex Seem. in Bonplandia 9: 261. 1861, Viti, 444. 1862, Fl. Vit. 322. 1868; Gibbs in J. Linn. Soc. Bot. 39: 182. 1909; Summerhayes & Hubbard in Kew Bull. 1927: 43. 1927, in op. cit. 1930: 263. 1930; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 20: 15. 1949; J. W. Parham in Dept. Agr. Fiji Bull. 30: 21. 1956, Pl. Fiji Isl. 301. 1964, ed. 2. 398. 1972.

Centothecha latifolia Trin. Fund. Agrost. 141, nom. illeg. 1820.

Perennial, the culms 30–120 cm. high; leaf blades 5–15 cm. long, 1.2–3 cm. broad, with numerous transverse veins between the main and secondary nerves, the midrib and nerves more pronounced on lower surface; inflorescence an open panicle 7.5–20 cm. long, the racemes simple, 5–15 cm. long; spikelets green, ovate-oblong, 3–5 mm. long, not borne in rows, the upper glume mucronate, the lemma lacking an awn.

TIPIFICATION: The material originally described was from India.

DISTRIBUTION: Widely distributed in southeastern Asia, China, Pacific areas, and tropical Africa. In Fiji it was apparently first collected by Seemann (no. 684), who reported that it was common throughout. *Centosteca lappacea* is found in shady places, both moist and dry, from sea level up to 1,000 m. or higher, probably being the most common of the indigenous grasses. Its abundance is indicated by the fact that more than 90 Fijian herbarium collections are available. Flowers and fruits may be expected at any season.

LOCAL NAMES AND USE: *Luna*; *mbitumbitu*. The latter name is noted only on *Degener 15123*; that collector also reports that leaves of the species are mashed and used on cut fingers.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Mt. Evans Range, *Smith 4282*; vicinity of Nandari-vatu, *Degener 14293*. NANDRONGA & NAVOSA: Nausori Highlands, *DA 12631* (*Melville et al. 7002*). NAMOSI: Valley of Wainambua Creek, south of Mt. Naitarandamu, *Smith 8832*. SERUA: Vicinity of Ngaloa, *Degener 15123*. RA: Ndombuilevu Farm, *DA 1681*; Naingani Island, *DA 3373*. NAITASIRI: Tholo-i-suva, *DA 12003*. TAILEVU: Wailotua Cave, *DA 9417*. REWA: Kamba Point, *DA 9337*. MBENGGA: *DA 9616*. KANDAVU: Vunisea, *DA 8983*. OVALAU: Wainaloka, *DA 1346*. KORO: Ndelaikoro, *DA 15833*. NGAU: Shore of Herald Bay, *Smith 7937*; without further locality, *MacGillivray*, Sept. 1854. VANUA LEVU: MATHUATA: Ndaku road, *DA 8800*; Seanggangga Plateau, *Smith 6689*. THAKAUNDROVE: Maravu Estate, *DA 8822*. TAVEUNI: Nalele, *DA 8910*. MOALA: *Bryan 298*. VANUA

MBALAVU: Lomaloma, *DA 10217*. FIJI without further locality, *Seemann 684*, *Milne & MacGillivray*. Summerhayes and Hubbard (1927, 1930) have also noted collections from the islands of Naviti (Yasawa Group), Wakaya, and Nairai.

4. *DACTYLIS* L. Sp. Pl. 71. 1753, Gen. Pl. ed. 5. 32. 1754.

Spikelets few-flowered, compressed, finally disarticulating between the florets, the glumes unequal, carinate, acute, hispid-ciliate on keel, the lemmas compressed, keeled, mucronate, 5-nerved, ciliate on keel.

LECTOTYPE SPECIES: *Dactylis glomerata* L. (as *D. glomeratus*). (ING).

DISTRIBUTION: Five temperate species found in parts of Europe and Asia are generally recognized. Only one, *Dactylis glomerata*, has been recorded from Fiji.

1. *Dactylis glomerata* L. Sp. Pl. 71, as *D. glomeratus*. 1753; Summerhayes & Hubbard in Kew Bull. 1930: 264. 1930; B.E.V. Parham in Agr. J. Dept. Agr. Fiji 20: 16. 1949; Greenwood in J. Arnold Arb. 36: 400. 1955; J.W. Parham in Dept. Agr. Fiji Bull. 30: 23. 1956.

TIPIFICATION: Linnaeus originally cited several earlier references, adding: "*Habitat in Europae cultis ruderatis.*"

DISTRIBUTION: Europe, North America, and temperate parts of Asia; introduced into many other temperate regions. It was collected near Nandarivatu (Mba Province, Viti Levu) by Tothill in 1927 and reported to be naturalized. Trials carried out at Nanduruloulou (Naitasiri Province) in 1934 were a failure, and the species has not been recorded in Fiji since Tothill's collection. In 1955 Greenwood suggested that it has not persisted in Fiji and might be dropped from floristic lists.

LOCAL NAMES AND USE: *Cocksfoot grass*; *orchard grass*. Although a valuable pasture grass, this species is obviously not useful in Fiji.

5. *TRITICUM* L. Sp. Pl. 85. 1753, Gen. Pl. ed. 5. 37. 1754.

Annual, with fairly tall culms and flat leaf blades; spikelets 2-5-flowered, solitary at each node of rachis, the glumes rigid and keeled, 3-nerved, the apex abruptly mucronate with 1-several nerves, the lemmas broad, keeled, many-nerved, sharply pointed or awned.

LECTOTYPE SPECIES: *Triticum aestivum* L. (ING).

DISTRIBUTION: Europe, the Mediterranean area, and western Asia, but with some species widely cultivated. Probably about 20 species are represented in the wild, but additionally there are many cultivars. Only one species, *Triticum aestivum*, has been recorded from Fiji.

1. *Triticum aestivum* L. Sp. Pl. 85. 1753; J.W. Parham in Dept. Agr. Fiji Bull. 30: 23. 1956, Pl. Fiji Isl. 312. 1964, ed. 2. 413. 1972.

TIPIFICATION: Linnaeus cited several earlier references, doubtless based on cultivated European plants.

DISTRIBUTION: Widely cultivated in all parts of the world, although apparently a hexaploid species not represented in the wild. This valuable cereal is occasionally found growing as a result of seeds being accidentally dropped near stores or in wharf areas, hence its inclusion here. Trials have been carried out in Fiji with seed from Queensland (1937 and 1964), New South Wales (1964), India (1964), Kenya (1964), and Mexico (1970), but growth and yields have been disappointing.

LOCAL NAME AND USE: *Wheat*; this of course is one of the most valuable food plants in the world, although it has not been successfully grown in Fiji.

AVAILABLE COLLECTION: VITI LEVU: NAITASIRE: Koronivia, DA 9055; this single voucher is from a small and stunted plant which was in flower in February.

6. *HORDEUM* L. Sp. Pl. 84. 1753, Gen. Pl. ed. 5. 37. 1754.

Annuals or perennials, with erect culms and flat, fairly narrow leaf blades; spikelets in clusters of 2-6 at each node of rachis, the back of the lemma turned from the rachis, the rachilla separating at maturity above the glumes and, in the middle spikelet, prolonged behind the palea as a bristle, the glumes narrow, often awned, the lemmas tapering into a long awn.

LECTOTYPE SPECIES: *Hordeum vulgare* L. (ING).

DISTRIBUTION: Temperate climates, some species being widely cultivated. About 20 species are recognized, only one of which, *Hordeum vulgare*, has been noted in Fiji.

1. *Hordeum vulgare* L. Sp. Pl. 84. 1753; B. E. V. Parham in Agr. J. Dept. Agr. Fiji **20**: 17. 1949; J. W. Parham in Dept. Agr. Fiji Bull. **30**: 23. 1956.

TIPIFICATION: Linnaeus cited several earlier references, doubtless referring to cultivated European plants.

DISTRIBUTION: Widely cultivated in temperate regions of the world, and occasionally seen growing near stores or on wharf areas in Fiji.

LOCAL NAMES AND USE: *Barley*; *jau* (Hindi); the cultivated barley is one of the most widely utilized grasses.

Barley was introduced into Fiji for trials in 1920 and 1934, but it cannot be successfully grown there and is seen relatively rarely. No herbarium vouchers seem to be available.

7. *ARUNDO* L. Sp. Pl. 81. 1753, Gen. Pl. ed. 5. 35. 1754.

Tall, perennial reeds, with broad, linear leaf blades; inflorescence a large, terminal, plumelike panicle; spikelets several-flowered, with successively smaller florets, the rachilla disarticulating above glumes and between florets, the glumes somewhat unequal, membranaceous, 3-nerved, narrow, tapering to a slender point, the lemmas thin, 3-nerved, densely pilose, gradually narrowing, the nerves ending in slight teeth.

LECTOTYPE SPECIES: *Arundo donax* L. (ING).

DISTRIBUTION: About 20 species are known, from tropical and temperate countries. Two varieties of *Arundo donax* have been recorded from Fiji.

1. *Arundo donax* L. Sp. Pl. 81. 1753; A. C. Sm. in Sargentia **1**: 6. 1942; Greenwood in J. Arnold Arb. **30**: 84. 1949; B. E. V. Parham in Agr. J. Dept. Agr. Fiji **20**: 15. 1949; J. W. Parham in Dept. Agr. Fiji Bull. **30**: 25. fig. 8. 1956, Pl. Fiji Isl. 300. 1964, ed. 2. 395. 1972.

Culms caespitose, 1.8-5.4 m. high, sparingly branched from thick rhizomes; leaf blades numerous, 35-75 cm. long, 2.5-6 cm. broad, with scabrous margins; inflorescence an erect, plumelike panicle 45-90 cm. long, with branches 10-30 cm. or more long; spikelets crowded, the florets surrounded by numerous silky bristles.

TIPIFICATION: Several earlier references are mentioned by Linnaeus, who indicated the locality: "*Habitat in Hispania, Galloprovincia.*"

DISTRIBUTION: Tropical Asia and the Mediterranean area; introduced into the New World and elsewhere, including at least Fiji and Hawaii in the Pacific.

KEY TO VARIETIES

Plant naturalized and widespread; leaf blades and sheaths blue-green in color. 1a. var. *donax*
 Plant cultivated as an ornamental, apparently restricted to gardens; leaf blades with distinctive white
 stripes. 1b. var. *versicolor*

1a. *Arundo donax* L. var. *donax*

The species was first noted from Fiji by Smith in 1942. It is now widespread, at least on Viti Levu and no doubt on some of the other islands, occurring at elevations up to about 200 m. on hillsides, in open forest, and along roadsides. Flowers have been noted from March to May.

LOCAL NAMES AND USES: *Giant reed*; *ngasau ni vavalangi* (i.e. European or introduced reed). It is a handsome grass useful for house-building, making fish-fences, stabilizing earth on embankments, and as an ornamental.

AVAILABLE COLLECTIONS: VITI LEVU: NANDRONGA & NAVOSA: Upper Singatoka Valley, DA 10826. SERUA: *Degener 15170*; inland from Ngaloa, DA 16809. NAITASIRI: Vunindawa, DA 7955; Prince's Road, DA 7589. REWA: Vicinity of Suva, *Wilder 1232*.

1b. *Arundo donax* var. *versicolor* (Mill.) Stokes, Bot. Mat. Med. 1: 160. 1812; J. W. Parham in Dept. Agr. Fiji Bull. 30: 25. 1956, in Agr. J. Dept. Agr. Fiji 29: 31. pl. 2. 1959, Pl. Fiji Isl. 300. 1964, ed. 2. 395. 1972.

Arundo versicolor Mill. Gard. Dict. ed. 8. 1768.

A handsome ornamental reed with white-striped leaf blades.

TIPIFICATION: Miller's taxon was doubtless based on a cultivated plant.

DISTRIBUTION: Widely cultivated; although it was not recorded from Fiji until 1956, it had certainly been introduced at a much earlier date. It flowers between April and July.

USE: This variety is cultivated in European gardens, as in the Botanical Gardens in Suva; it is also moderately commonly cultivated in Fijian gardens, but it does not appear to be naturalized.

AVAILABLE COLLECTIONS: VITI LEVU: NAITASIRI: Kasavu Village, DA 2412. REWA: Suva Botanical Gardens, DA 12165.

8. *ERAGROSTIS* Wolf, Gen. Pl. Vocab. Char. Def. 23. 1776.

Annuals or perennials; panicle open or contracted, bearing few- to many-flowered spikelets, the florets generally imbricate, the rachilla disarticulating above the glumes and between the florets, the lemmas deciduous, acuminate or acute, keeled or rounded on the back, 3-nerved, the nerves usually prominent; paleae sometimes persistent, 2-nerved, the keels sometimes ciliate, the glumes sometimes unequal, acuminate or acute, 1-nerved.

LECTOTYPE SPECIES: *Eragrostis minor* Host (*Poa eragrostis* L.) (ING).

DISTRIBUTION: A cosmopolitan genus of about 300 species, mostly tropical and subtropical. Six species have been recorded from Fiji, of which one is endemic and three introduced and naturalized. The other two species are recent introductions, mentioned at the end of this treatment; of them only one, *Eragrostis curvula*, seems to have become very locally established.

KEY TO SPECIES

Plants 30–60 cm. tall.

Panicle open, the spikelets small, narrow, 3–4 mm. long, about 1 mm. broad, gray-green in color, the glumes markedly unequal. 1. *E. pilosa*

Panicle with ascending branches but more or less open, the spikelets 5–6 mm. long, 2–3 mm. broad, purplish in color, the paleae deciduous. 2. *E. unioloides*

Panicle branchlets solitary, appressed, densely flowered from base, the spikelets light yellow-green in color, the glumes scabrous on keel, the nerves of lemmas minutely scabrous. 3. *E. scabriflora*

Plants less than 30 cm. tall; panicle open, with whorled branches, the spikelets numerous, about 2 mm. long and 1 mm. broad, greenish, the paleae markedly ciliate. 4. *E. tenella*

1. ***Eragrostis pilosa* (L.) Beauv. Ess. Nouv. Agrost. 71. 1812; Summerhayes & Hubbard in Kew Bull. 1927: 42. 1927; Greenwood in J. Arnold Arb. 30: 84. 1949; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 20: 17. 1949, in Proc. 7th Pacific Sci. Congr. 5: 233. 1953; J. W. Parham in Dept. Agr. Fiji Bull. 30: 29. 1956, Pl. Fiji Isl. 305. 1964, ed. 2. 402. 1972.**

FIGURE 71A.

Poa pilosa L. Sp. Pl. 68. 1753.

Annual, the culms slender, erect, 30–60 cm. high; leaf blades short and narrow, 1–3 mm. broad; panicle delicate, open, 5–20 cm. long, the racemes 3–7 cm. long, flexuous, spreading or ascending, branched; spikelets 4–10-flowered, lacking awns, breaking up at maturity and leaving acute glumes on their stalks.

TYPIFICATION: After an earlier reference, Linnaeus indicates: "*Habitat in Italia.*"

DISTRIBUTION: Southern Europe and most warm parts of the world. In Fiji it seems to have been first collected by Greenwood from Lautoka during the 1920's. Subsequently it has been observed at elevations from sea level to about 800 m., sprawling or in dense clumps on hillsides, in swamps, on cultivated land, and along roadsides. Flowers have been noted from March through July and also in October. Approximately 20 collections are available from Fiji, all from Viti Levu.

LOCAL NAME AND USE: Often referred to as *Indian love grass*, this naturalized species is a minor weed of cultivation.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Lautoka, *Greenwood 2*; near Lautoka golf course, *DA 8220*; between Mba and Lautoka, *DA 8203*; Vatia, *DA 2835*; near Navai, *Greenwood 1175*. NANDRONGA & NAVOSA: Upper Singatoka Valley, *DA 7967*; near Keiasi, *DA 10168*. RA: Near Ellington, *DA 7915*; Thamboni, *DA 2832*. NAITASIRI: Agricultural Station, Koronivia, *DA 4005*; vicinity of Nasinu, *Gillespie 3572*. REWA: Suva, *C. R. Turbet 40*; Ndelaivivesi, *DA 9092*.

2. ***Eragrostis unioides* (Retz.) Nees ex Steudel, Syn. Pl. Glum. 1: 264. 1854; A. C. Sm. in Bull. Torrey Bot. Club 70: 534. 1943; Greenwood in J. Arnold Arb. 25: 405. 1944; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 20: 17. 1949, in Proc. 7th Pacific Sci. Congr. 5: 236. 1953; J. W. Parham in Fiji Dept. Agr. Bull. 30: 27. fig. 10. 1956, in op. cit. 35: 156. fig. 80. 1959, Pl. Fiji Isl. 305. 1964, ed. 2. 402. 1972.**

FIGURE 71B.

Poa unioides Retz. Obs. Bot. 5: 19. 1789.

Eragrostis cilianensis sensu J. W. Parham in Dept. Agr. Fiji Bull. 30: 27, p. p. 1956, Pl. Fiji Isl. 305, p. p. 1964; non Vignolo-Lutati.

Culms erect, 25–60 cm. high; leaf blades flat, narrow, 7.5–15 cm. long, 1.5–3 mm. broad; panicle 7–15 cm. long, the racemes purplish, ascending, 2–7 cm. long, branched; spikelets ovate, compressed, truncate at base, obtuse at apex, 10–25-flowered, usually purplish in color, the paleae and lemmas usually falling together.

TYPIFICATION: The original material probably came from India.

DISTRIBUTION: Originally from southern Asia, but now widespread. It was first recorded from Fiji by Smith in 1943 on the basis of a Greenwood specimen from Singatoka, although Greenwood had earlier seen it at Navua (Serua Province) in 1939. It is now known to occur with some frequency on Viti Levu (about 30 collections being available) from sea level to about 200 m. in fields, pastures, and along roadsides. Flowers have been observed from February through October. It is a moderately common weed locally and probably is to be expected on other islands.



REPRESENTATIVE COLLECTIONS: VITI LEVU: NANDRONGA & NAVOSA: Singatoka, *Greenwood 815A*. SERUA: Ndeumba, *DA 8639*; Navua, *DA 6084*. NAMOSI: Navua road, *DA 1187*. NAITASIRI: Vunindawa, *DA 8453*; Nasinu, *DA 7526*; Wainimbuku, *DA 8709*. TAILEVU: Waimaro, *DA 7713*; east of Wainimbuka River, near Ndakuivuna, *Smith 7093*. REWA: Waingganaki, Queen's Road, *DA 7592*.

3. *Eragrostis scabriflora* Swallen in J. Wash. Acad. Sci. **26**: 179. 1936, in J. Arnold Arb. **31**: 142. 1950; J. W. Parham in Dept. Agr. Fiji Bull. **30**: 31. 1956, Pl. Fiji Isl. 305. 1964, ed. 2. 402. 1972. FIGURE 71C.

Eragrostis elongata sensu Summerhayes & Hubbard in Kew Bull. **1930**: 262. 1930; J. W. Parham in Dept. Agr. Fiji Bull. **30**: 29. 1956, Pl. Fiji Isl. 305. 1964; non Jacq.

Perennial, the culms erect, densely tufted, 20–60 cm. high; leaf blades 5–15 cm. long, 1–2 mm. broad, flat or loosely folded, scabrous; panicle 3–15 cm. long, the branches solitary, appressed, densely flowered from base; spikelets 6–8-flowered, short-pedicellate, appressed to branches.

TYPIFICATION AND NOMENCLATURE: The holotype is *Bryan 528* (BISH), collected Aug. 30, 1924, on the island of Aiwa, Lau Group, in bare spots in a wooded basin and on limestone ridges; isotypes are available at BISH and US. The species was recorded as *Eragrostis elongata* Jacq. by Summerhayes and Hubbard, but that is now seen not to occur in Fiji.

DISTRIBUTION: Endemic to Fiji, and thus far known from only a few islands in the Lau Group and in Loma-i-Viti; it has been collected between 10 and 60 m. on bare, dry hillsides and limestone ridges, becoming luxuriant in moist hollows. Flowers and the purplish yellow-green fruit have been collected in August.

AVAILABLE COLLECTION: OLORUA (Lau Group): *Bryan 520*. It is also known to occur on Koro, Lakeba, Kambara, and Fulanga, islands from which Summerhayes and Hubbard reported it as *E. elongata*.

4. *Eragrostis tenella* (L.) Beauv. ex Roemer & Schultes, Syst. Veg. **2**: 576. 1817; Summerhayes & Hubbard in Kew Bull. **1930**: 262. 1930; J. W. Parham in Dept. Agr. Fiji Bull. **30**: 29. 1956, Pl. Fiji Isl. 305. 1964, ed. 2. 402. 1972. FIGURE 71D.

Poa tenella L. Sp. Pl. 69. 1753.

Poa amabilis L. Sp. Pl. 68. 1753.

Poa plumosa Retz. Obs. Bot. **4**: 20. 1786 (or 1787).

Eragrostis plumosa Link. Hort. Reg. Bot. Berol. **1**: 192. 1827; Summerhayes & Hubbard in Kew Bull. **1927**: 42. 1927.

Eragrostis amabilis Wight & Arn. ex Hook. & Arn. Bot. Beechey Voy. **251**. 1838; B. E. V. Parham in Agr. J. Dept. Agr. Fiji **20**: 17. 1949; J. W. Parham in Dept. Agr. Fiji Bull. **30**: 27, fig. 9. 1956.

Eragrostis cilianensis sensu J. W. Parham in Dept. Agr. Fiji Bull. **30**: 27, p. p. 1956, Pl. Fiji Isl. 305, p. p. 1964; non Vignolo-Lutati.

Annual, the culms slender, branching, 10–30 cm. high; leaf blades usually involute, 5–10 cm. long, about 1 mm. broad; panicle open, up to 10 cm. long, the racemes 5–10 mm. long, branched; spikelets numerous, greenish, 4–8-flowered.

TYPIFICATION AND NOMENCLATURE: *Poa tenella* and *P. amabilis* were typified by Linnaeus by Indian plants. I have not been able to verify the typification of *Poa plumosa*, but doubtless it also is based on material from southeastern Asia.

DISTRIBUTION: Originally from southern tropical Asia, but now found throughout the warmer regions of the world. It was first reported from Fiji in 1927 by Summerhayes and Hubbard (as *Eragrostis plumosa*), but it is now moderately common in waste places and clearings, along roadsides, on dry, bare hillsides, and in moist hollows on hillsides, at elevations from sea level to about 200 m. Flowering specimens have been seen essentially throughout the year.

FIGURE 71. *Eragrostis*; terminal portions of inflorescences, all $\times 4$; A, *E. pilosa*, from *Greenwood 1175*; B, *E. unioides*, from *Smith 7093*; C, *E. scabriflora*, from *Bryan 528*; D, *E. tenella*, from *DA 16879*.

LOCAL NAME AND USE: *Love grass*; it has become a minor weed of cultivation and waste places.

AVAILABLE COLLECTIONS: VITI LEVU: TAILEVU: Matavatathou, *DA 7781*. NAITASIRI: Nanduruloulou, *DA 737*. REWA: Suva, *DA 8964, 9086*. KANDAVU: Naloto, *DA 3001*. OVALAU: Vicinity of Levuka, Gillespie 4461.1. VANUA LEVU: MATHUATA: Lambasa, *Greenwood 663*. THAKAUNDROVE: Namawa Estate, *DA 8820*; Vunilangi, *DA 8955*; near Mbutha, Mbutha Bay, *DA 16879*. TAVEUNI: Waiyevo, *DA 5734*. OLORUA (Lau Group): *Bryan 519*. FIJI without definite locality, *DA 3656, 3895, 5566*. Summerhayes and Hubbard in 1930 reported that Dr. and Mrs. Tothill found this species on several islands not listed above, throughout Loma-i-Viti and the Lau Group.

RECENTLY INTRODUCED SPECIES OF ERAGROSTIS

In addition to the four species discussed above, *Eragrostis tef* (Zucc.) Trotter (*E. abyssinica* (Jacq.) Link) was introduced for trial at the Plant Introduction and Quarantine Station, Nanduruloulou (Naitasiri Province), as *FDA 13871*. It is represented by three specimens (*DA 7385, 8327, 9043*) but it has not persisted; cf. J. W. Parham in Fiji Dept. Agr. Bull. 30: 31. 1956, Pl. Fiji Isl. 402. 1964.

Eragrostis curvula (Schrader) Nees, introduced for trial in 1963 as *FDA 15711*, had still survived in 1970 in trial plots in the Mba Closed Area (Mba Province, Viti Levu); it is represented by *DA 17327*; cf. J. W. Parham, Pl. Fiji Isl. ed. 2. 402. 1972.

9. ELEUSINE Gaertn. Fruct. Sem. Pl. 1: 7. 1788; Seem. Fl. Vit. 322. 1868.

Annuals; flowering culms with 2-several stout spikes arising from the apices and 1 or 2 spikes given off a short distance below; spikelets few- to several-flowered, compressed, sessile, imbricate in 2 rows along one side of a fairly wide rachis, the rachilla disarticulating above glumes and between florets; glumes unequal and fairly broad, acute, 1-nerved, the lemmas acute, strongly 3-nerved, the nerves running close together to form a keel; seeds dark brown, with transverse ridges.

LECTOTYPE SPECIES: *Eleusine coracana* (L.) Gaertn. (*Cynosurus coracanus* L.) (ING).

DISTRIBUTION: A genus of about nine tropical and subtropical species. Two species are noted in Fiji, of which one (*Eleusine indica*) is naturalized and has become a very common weed; the second (*E. coracana*) is uncommon and probably only occasionally cultivated.

KEY TO SPECIES

Spikes slender, narrow, about 5 mm. wide, straight, nearly glabrous at base; seeds oblong. . . 1. *E. indica*
Spikes stout, broad, about 1 cm. wide, incurved, hairy at base; seeds globose. 2. *E. coracana*

1. *Eleusine indica* (L.) Gaertn. Fruct. Sem. Pl. 1: 8. 1788; Seem. in Bonplandia 9: 683. 1861, Viti, 444. 1862, Fl. Vit. 322. 1868; Summerhayes & Hubbard in Kew Bull. 1927: 43. 1927, in op. cit. 1930: 263. 1930; B. E. V. Parham, Fijian Pl. Names, 54. 1942; Greenwood in J. Arnold Arb. 25: 405. 1944; J. W. Parham in Agr. J. Dept. Agr. Fiji 19: 103. 1948; B. E. V. Parham in op. cit. 20: 17. 1949, in Proc. 7th Pacific Sci. Congr. 5: 222-236. 1953; J. W. Parham in Dept. Agr. Fiji Bull. 30: 32. fig. 11. 1956, in op. cit. 35: 156. fig. 81. 1959, Pl. Fiji Isl. 304. 1964, ed. 2. 402. 1972.

Cynosurus indicus L. Sp. Pl. 72. 1753.

Annual, growing in clumps, branching from base, 40-120 cm. high; leaf blades usually flat but sometimes folded, 15-30 cm. long, 4-6 mm. broad; spikes mostly 2-6, usually 5 (4 digitate and 1 given off slightly below apex of culm), 4-10 cm. long; spikelets dark green, breaking up at maturity, leaving glumes overlapping in 2 rows on one side of flattened rachis.

TYPEIFICATION: Linnaeus mentioned several earlier references and added: "*Habitat in Indiis.*"

DISTRIBUTION: A common weed throughout the warmer regions of the world. Seemann first reported it from Fiji, indicating that it was found on roadsides throughout Fiji in 1860. It is now widespread from sea level to about 800 m. in villages, on cultivated land, in pastures, along roadsides, in open places, along stream banks and beaches, and on open gravel banks. It flowers throughout the year. Approximately 90 collections are at hand, and therefore only a few representative ones are listed below.

LOCAL NAMES AND USE: *Goose grass, goose foot, crow's foot grass, wire grass, kavoronaisivi, and vorovorovisi*. It is a common weed which is difficult to eradicate.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Lautoka, *Greenwood*, Dec. 13, 1925; Malele, Nandarivatu road, *DA 8158*; near Nandala Creek, *Gillespie 4135*. NANDRONGA & NAVOSA: Yanutha Island, *DA 9023*; Lombau Farm, *DA 7991*. SERUA: Vicinity of Ngaloa, *Smith 9452*. NAMOSI: Wainilotulevu, *DA 9100*; near Namuamua, *Smith 9065*. RA: Demonstration Farm, Ndombuilevu, *DA 7309*; Naingani Island, *DA 3351*. NAITASIRE: Waindina River basin, *MacDaniels 1059*; Nanduruloulou, *DA 7473*. TAILEVU: Navuloa, *DA 9319*; Ndakuivuna, Wainimbuka River, *Smith 7080*. REWA: Lokia, *DA 8597*. MBENGGA: *DA 9082*. KANDAVU: Ngaloa, *DA 9077*. OVALAU: Valley of Mbureta and Lovoni Rivers, *Smith 7392*. NGAU: Hills east of Herald Bay, *Smith 7971*. VANUA LEVU: MATHUATA: Tambia, *DA 8749*. THAKAUNDROVE: Valethi, *DA 8844*. TAVEUNI: Vicinity of Waiyevo, *Smith 8121*. MATUKU: Bryan 233. LAKEMBA: Near Tumbou, *Garnock-Jones 877*. FIJI without further locality, *Home, Seemann 683*.

2. *Eleusine coracana* (L.) Gaertn. Fruct. Sem. Pl. 1: 8. *t. 1, fig. 11*. 1788; B.E.V. Parham in Agr. J. Dept. Agr. Fiji 20: 17. 1949; J.W. Parham in Dept. Agr. Fiji Bull. 30: 32. 1956, Pl. Fiji Isl. 304. 1964, ed. 2. 402. 1972.

Cynosurus coracanus L. Syst. Nat. ed. 10. 875. 1759.

Annual, the culms erect, 60–90 (up to 150) cm. high; leaf blades 30–60 cm. long, 6–12 mm. broad; spikes usually about 6 (5 digitate and 1 given off a marked distance below apex of culm), 4–6 cm. long, erect and fairly close together; spikelets usually 6-flowered, light green, turning brown at maturity.

TYPEIFICATION: The original locality is the East Indies, Linnaeus giving references to works by Rheede, Rumphius, and Plukenet.

DISTRIBUTION: Originally grown in southern Asia and Africa as a minor cereal, from which an alcoholic beverage can be made. It is occasionally grown in Fiji in Indian settlements, but it seems not to have become truly adventive. Flowers and fruit have been noted between March and August.

LOCAL NAMES AND USE: *African millet, finger millet, mandua* (Hindi). It is occasionally cultivated as a cereal.

AVAILABLE COLLECTIONS: VITI LEVU: NAITASIRE: Koronggangga, *DA 2737*; Nakandi, *DA 2801*; Research Station, Koronivia, *DA 3949*; Plant Introduction and Quarantine Station, Nanduruloulou, *DA 8473*. FIJI without further locality, *DA 3235*.

In some of the citations mentioned above and elsewhere, the epithet has been erroneously spelled "*corocana*." Although "*coracana*" is correct, I have not attempted to indicate which spelling has been used in the different citations.

10. DACTYLOCTENIUM Willd. Enum. Pl. Hort. Berol. 1029. 1809.

Annuals or perennials, with flat leaf blades; spikes 2–several, short, broad, digitate and spreading at summits of culms; spikelets 3–5-flowered, sessile in 2 rows along one side of narrow rachis, the end of rachis projecting beyond spikelets; ra-

chilla disarticulating above first glume and between florets, the lemmas broad, keeled, acuminate or with a short awn; seeds ridged, enclosed in a thin pericarp.

LECTOTYPE SPECIES: *Dactyloctenium aegyptium* (L.) Willd., as *D. aegyptiacum* (*Cynosurus aegyptius* L.) (ING).

DISTRIBUTION: About ten species are recorded, from the warmer parts of the world. Only one species has been recorded from Fiji, where it is not common although it is a geographically widespread species.

1. *Dactyloctenium aegyptium* (L.) Willd. Enum. Pl. Hort. Berol. 1029, as *D. aegyptiacum*. 1809; Beauv. Ess. Nouv. Agrost. Atlas, pl. 15, fig. 2. 1812; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 20: 16. 1949; J. W. Parham in Dept. Agr. Fiji Bull. 30: 34, fig. 12. 1956, Pl. Fiji Isl. 303. 1964, ed. 2. 399. 1972.

Cynosurus aegyptius L. Sp. Pl. 72. 1753.

Culms spreading, branched, rooting at nodes, 25–60 cm. high; leaf blades narrow, ciliate, 7–25 cm. long, 1.5–6 mm. broad; spikes 2–6, digitate, 2–6 cm. long, the rachis projecting beyond spikelets; spikelets purplish, in rows on lower side of rachis, 3–5-flowered, the lower ones markedly awned.

TYPIFICATION: Linnaeus cites several earlier references and then indicates: “*Habitat in Africa, Asia, America.*”

DISTRIBUTION: Doubtless native in the tropical regions of the Old World, but now spread to tropical America and elsewhere. In Fiji it is found from sea level to about 30 m., but it is nowhere common. Flowers have been noted in January, April, June, September, and November. No local name has been recorded in Fiji.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Lautoka, DA 13267. TAILEVU: DA 7561. REWA: Lautha-la Bay, DA 2925. VANUA LEVU: THAKAUNDROVE: Vunlangi, DA 8954.

11. *SPOROBOLUS* R. Br. Prodr. Fl. Nov. Holl. 169. 1810.

Annuals or perennials; spikelets small, 1-flowered, in open or contracted panicles, the rachilla disarticulating above the glumes; glumes 1-nerved, usually unequal, the second glume often the same length as the spikelet, the lemma 1-nerved, membranaceous, lacking an awn, the palea usually prominent and same length as lemma, falling at maturity; caryopsis free of lemma, the pericarp thin, overlapping seed but free from it.

LECTOTYPE SPECIES: *Sporobolus indicus* (L.) R. Br. (*Agrostis indica* L.) (ING).

DISTRIBUTION: A genus of about 150 species spread throughout the tropical and warm temperate regions of the world. Five species, apparently all introduced and naturalized, have been recorded from Fiji. A sixth species, *Sporobolus creber* J. De Nardi (in Contr. New South Wales Nat. Herb. 4: 406–411. 1973) has been recorded from Mba Province, Viti Levu (from near Lautoka and Nandarivatu). It has not become naturalized and presumably will not persist, being represented only by two collections.

KEY TO SPECIES

Grasses of littoral areas, with deep, extensive rhizomes, usually growing in sand; leaves numerous, the blades inrolled; panicle spike-like, the spikelets crowded, the lower glume almost as long as the spikelet. 1. *S. virginicus*

Grasses not found in littoral areas; leaves few, narrow, given off from base.

Panicle branches ascending, loosely appressed; spikelets elliptic, 1.6–2 mm. long, not borne continuously on branches, the upper glume acute or sometimes obtuse, half as long as spikelet; grain large, about 1.25 mm. long. 2. *S. jacquemontii*

Panicle branches erect, dense; spikelets borne to base of branches, elliptic, the lower glume half to 2/3 length of spikelet; caryopsis not more than half length of spikelet, about 1.25 mm. long.

3. *S. indicus*

Panicle loose, with ascending branches; spikelets not borne to base of branches, the lower glume much shorter than lemma. 4. *S. diander*
 Panicle spikelike; spikelets small, about 1.5 mm. long, the upper glume acute, about half as long as spikelet; grain truncate, about 1 mm. long. 5. *S. elongatus*

1. *Sporobolus virginicus* (L.) Kunth, Rév. Gram. 67. 1829; Summerhayes & Hubbard in Kew Bull. 1930: 262. 1930; J. W. Parham in Dept. Agr. Fiji Bull. 30: 45. 1956, Pl. Fiji Isl. 312. 1964, ed. 2. 412. 1972.

Agrostis virginica L. Sp. Pl. 63. 1753.

Perennial; culms erect or ascending from long, creeping, buried rhizomes, up to 20 cm. high, covered by dense overlapping leaf sheaths buried at mouth; leaf blades narrow, inrolled, 2–15 cm. long, about 1.5 mm. broad; panicle short, dense, spike-like, 1.2–8 cm. long, 6–9 mm. broad, the racemes appressed, 0.5–2.5 cm. long.

TYPIFICATION: Linnaeus cites only *Flora Virginica*, and a Clayton collection is doubtless the primary basis of the species.

DISTRIBUTION: Recorded from sandy localities in the tropics of both hemispheres. This short, tough beach grass is certainly not common in Fiji, being known only from the Singatoka area and from two Lau islands, Kambara and Fulanga (reported by Summerhayes and Hubbard). Flowers have been noted in January and February. No local names have been recorded for it in Fiji.

AVAILABLE COLLECTIONS: VITI LEVU: NANDRONGA & NAVOSA: Near Singatoka, DA 3266; near Namanda Village, DA 9062; Korotonga Beach, DA 17319.

2. *Sporobolus jacquemontii* Kunth, Rév. Gram. 427. t. 127. 1831; J. W. Parham, Pl. Fiji Isl. ed. 2. 412. 1972.

Sporobolus poiretii sensu J. W. Parham in Dept. Agr. Fiji Bull. 30: 47. fig. 17, II. 1956, in op. cit. 35: 156. fig. 82, II. 1959, Pl. Fiji Isl. 311. 1964; non Hitchcock.

Tufted perennial; culms erect, glabrous, 45–90 cm. high; sheaths glabrous, some of the culm exposed; leaf blades flat, involute, 10–20 cm. long, 1.5–3 mm. broad, tapering to a fine point; panicle spikelike, 10–30 cm. long, the lower branches loosely appressed, the upper branches ascending, 6–18 mm. long; spikelets crowded in clusters on branches, not continuous; caryopsis oblong, red-brown in color.

TYPIFICATION: The type locality is Santo Domingo (Dominican Republic) in the West Indies.

DISTRIBUTION: In addition to its American distribution, *Sporobolus jacquemontii* has been recorded from Indo-Malesia, Australia, and parts of Polynesia, being first recorded (as *S. poiretii*) from Fiji in 1956. It has been found only on the two largest islands, at elevations between sea level and 900 m., on open hillsides, riverbanks, and along roadsides. It is moderately common (I have seen about 25 collections). Flowers have been noted in most months between February and October.

LOCAL NAME AND USE: *Wire grass*; it has no economic value but, on the contrary, is a weed difficult to eradicate.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Mba Closed Area, DA 11134; Nandi, DA 9795. NANDRONGA & NAVOSA: Nausori Highlands, DA 1112. RA: Rakiraki, DA 7943. NAITASIRI: Tholo-i-suva, DA 3542; Koronivia, DA 7462, 7549; Tamavua, DA 7531; Sawani, DA 7656. TAILEVU: Waimaro, DA 7704. REWA: Vicinity of Suva, Turbet 28; Lokia, DA 8598. VANUA LEVU: MATHUATA: Tambia, DA 8766. THIAKAUNDOVE: Savusavu, DA 8846.

3. *Sporobolus indicus* (L.) R. Br. Prodr. Fl. Nov. Holl. 170. 1810; Summerhayes & Hubbard in Kew Bull. 1927: 41. 1927, in op. cit. 1930: 261. 1930; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 20: 20. 1949, in Proc. 7th Pacific Sci. Congr.

5: 230. 1953; J. W. Parham in Dept. Agr. Fiji Bull. 30: 44. *fig. 17, I.* 1956, in op. cit. 35: 156. *fig. 82, I.* 1959, Pl. Fiji Isl. 311. 1964.

Agrostis indica L. Sp. Pl. 63. 1753.

Perennial, the culms erect, solitary, 30–90 cm. high; leaf blades slender, about 25 cm. long, 0.7–3 mm. broad; panicle spikelike, the branches dense, erect, 1–4 cm. long; spikelets numerous, borne to base of branch; caryopsis not more than half length of spikelet.

TYPIFICATION: Apparently a Sloane specimen from Jamaica is the principal basis of Linnaeus's species.

DISTRIBUTION: Common in the warm parts of the world. It was first recorded from Fiji by Summerhayes and Hubbard in 1927 and is now moderately common in parts of the two largest islands, few collections being at hand. Flowers are noted during much of the year.

LOCAL NAMES AND USE: *Smut grass, wire grass*; it is palatable to stock only in its early stages and therefore is of limited economic value.

REPRESENTATIVE COLLECTIONS: VITI LEVU: SERUA: Naitonitoni, *DA 2850*; Tokotoko road, Navua, *DA 8653*. RA: Ndombuilevu, *DA 7322, 7838, 7847, 7858, 9065*. TAILEVU: Wainivesi road, *DA 7724*; Londoni, *DA 7772*; Waindawara, *DA 8438*. VANUA LEVU: MBUA: Nambouwalu, *DA 5774*. MATHU-ATA: Near Ndaku, *DA 8788*.

4. *Sporobolus diander* (Retz.) Beauv. Ess. Nouv. Agrost. 147. 1812; Summerhayes & Hubbard in Kew Bull. 1927: 41. 1927, in op. cit. 1930: 262. 1930; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 20: 20. 1949; J. W. Parham in Dept. Agr. Fiji Bull. 30: 43. *fig. 16.* 1956, in op. cit. 35: 156. 1959, Pl. Fiji Isl. 311. 1964, ed. 2. 411. 1972.

Agrostis diandra Retz. Obs. Bot. 5: 19. 1789.

Perennial, the culms tufted, slender, glabrous, 15–45 cm. high; leaves with glabrous sheaths, the blades narrow, 5–15 cm. long, 0.7–1.5 mm. broad; panicle narrow, fairly loose, 10–20 cm. long, the branches spreading to ascending, 0.5–1.5 cm. long; spikelets numerous, not borne to bases of branches.

TYPIFICATION: The type locality is India.

DISTRIBUTION: Found throughout tropical Asia and in parts of Australia. In Fiji it was first collected by Greenwood in the early 1920's and has become moderately common throughout the archipelago, even though it is very sparsely represented in herbaria. It occurs between sea level and about 150 m. in waste places and paddocks and along roadsides, flowering between February and June.

LOCAL NAME AND USE: *Indian dropseed*; it is of no use as a fodder or pasture grass and is difficult to eradicate, often occurring in compacted earth such as is found along roadsides.

AVAILABLE COLLECTIONS: VITI LEVU: NAITASIRI: Vicinity of Nasinu, *Greenwood s. n., Gillespie s. n.*; Nasinu Training College Farm, *DA 8058, 9118*. REWA: Suva, *DA 9123, 17343*. On the basis of Tot-hill collections, Summerhayes and Hubbard have also recorded *Sporobolus diander* from Koro, Ngau, Matuku, Vanua Mbalavu, and Mango.

5. *Sporobolus elongatus* R. Br. Prodr. Fl. Nov. Holl. 170. 1810; Summerhayes & Hubbard in Kew Bull. 1930: 262. 1930; Greenwood in J. Arnold Arb. 25: 405. 1944; J. W. Parham in Dept. Agr. Fiji Bull. 30: 45. 1956, Pl. Fiji Isl. 311. 1964, ed. 2. 412. 1972.

Tufted perennial, the culms erect, solitary; leaves mostly basal, the blades narrow, flat or inrolled, up to 50 cm. long, about 3 mm. broad; panicle spikelike, the

branches closely appressed; spikelets numerous, small, about 1.5 mm. long, breaking up at maturity; caryopsis small, round, shiny, about 1 mm. long.

TIPIFICATION: The original material was collected in Australia, the species occurring in both New South Wales and Queensland according to Brown.

DISTRIBUTION: Australia and Indo-Malesia into Polynesia. It was first collected in Fiji by Greenwood and Tothill, as reported by Summerhayes and Hubbard. It may be found from sea level to about 600 m., along roadsides and in waste places, on open hillsides, along riverbanks, and in plantations and cultivated fields. It flowers throughout most of the year and is fairly abundant.

LOCAL NAME AND USE: *Wire grass*; it is palatable to stock only when very young and therefore is not a useful pasture grass, being in fact a weed that is difficult to eradicate.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Nandi, *DA 9796*; Natawa, near Tavua, *DA 8172*; Wainimbothe, Nandarivatu road, *DA 8150*. NANDRONGA & NAVOSA: Yanutha Island, *DA 9033*; Lombau, *DA 7988*, NAITASIRI: Nasinu Training College Farm, *DA 8045*. TAILEVU: Waimaro, *DA 7704*. OVALAU: Wainaloka, *DA 1346*; Levuka, *DA 1364*. VANUA LEVU: THAKAUNDROVE: Nakama, Savusavu, *DA 5702*; Vunalandi, *DA 8953*. TAVEUNI: Waitavala, *DA 8894*; Vatuwiri, *DA 8915*; Vuna, *DA 5737*. VANUA MBALAVU: Lomaloma, coconut plantation, *DA 10235*. Also collected on Matuku and Lakemba by Dr. and Mrs. Tothill.

12. *CYNODON* L.C. Rich. in Pers. Syn. Pl. 1: 85. 1805; Clayton & Harlan in Kew Bull. 24: 185. 1970. Nom. cons.

Perennial, low-growing grasses, with creeping stolons; leaf blades short; spikes slender, digitate at apex of culms; spikelets 1-flowered, lacking awns, sessile on slender rachis in 2 rows, the rachilla disarticulating above glumes and prolonged above palea, the lemma, if present, rudimentary, the glumes narrow, acuminate, 1-nerved, shorter than floret.

TYPE SPECIES: *Cynodon dactylon* (L.) Pers. (*Panicum dactylon* L.) (ING).

DISTRIBUTION: Tropical and subtropical, with about ten species. *Cynodon dactylon*, a fairly cosmopolitan species, is naturalized in Fiji.

1. *Cynodon dactylon* (L.) Pers. Syn. Pl. 1: 85. 1805; Summerhayes & Hubbard in Kew Bull. 1927: 42. 1927, in op. cit. 1930: 263. 1930; B.E.V. Parham, Fijian Pl. Names, 54. 1942; Greenwood in J. Arnold Arb. 25: 405. 1944; J.W. Parham in Agr. J. Dept. Agr. Fiji 19: 103. 1948; B.E.V. Parham in op. cit. 20: 16. 1949, in Proc. 7th Pacific Sci. Congr. 5: 251. 1953; J.W. Parham in Dept. Agr. Fiji Bull. 30: 39. fig. 14. 1956, in op. cit. 35: 156. 1959, Pl. Fiji Isl. 302. 1964, ed. 2. 399. 1972.

Panicum dactylon L. Sp. Pl. 58. 1753.

Perennial, creeping extensively; leaf blades 2.5–10 cm. long, 1.5–6 mm. broad, mostly crowded at base of plant; ligule conspicuous, consisting of a ring of long white hairs; culms 10–38 cm. high, the spikes 2–6, usually 4 or 5, digitate; spikelets purplish, breaking up at maturity, leaving glumes overlapping in 2 rows on one side of rachis.

TIPIFICATION: Linnaeus gave several references and added: "*Habitat in Europa australis*."

DISTRIBUTION: Cosmopolitan. In Fiji it is widespread and common especially in dry areas of roadsides, riversides, and hillsides from sea level to 850 m. Sometimes it forms dense mats on the upper parts of beaches and at edges of mangrove swamps. It flowers throughout the year. About 40 collections are available.

LOCAL NAMES AND USES: *Couch grass*, *Bermuda grass*, *Australian couch*, *balama grass*, *kambuta* (the last of these is the only Fijian name). It is usually regarded as a weed of waste places and cultivation, but it can be used to make a reasonably good lawn in well-drained areas.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Sambeto Valley, *DA 8258*; shore of Mba River near mouth, *Smith 4736*; near Tavua, *DA 8190*; Nandarivatu, *DA 2099*. NANDRONGA & NAVOSA: Lombau Farm, *DA 7975*. SERUA: Between Ngaloa and Korovou, *Smith 9465*; Naitonitoni, near Navua, *DA 8646*. RA: Nanokonoko, *DA 7884*; Rakiraki, *DA 7923*. NAITASIRI: Nauluwai, Vunindawa, *DA 8429*; Navuso, *DA 2731*; Koronivia, *DA 3537*; vicinity of Nasinu, *Gillespie 3575*. REWA: Suva, *DA 7476*; Lokia, *DA 8595*. KANDAVU: *DA 5545*. VANUA LEVU: MATHUATA: Tambia, *DA 8752*; Vunitivi, Lambasa, *DA 10458*. THAKAUNDROVE: Savusavu airfield, *DA 8839*; Valethi, *DA 8864*. TAVEUNI: Waitavala, *DA 8895*. VANUA MBALAVU: Near Lomaloma, *Garnock-Jones 1117*. Summerhayes and Hubbard also list collections by Tothill from islands of Loma-i-Viti and the Lau Group.

13. CHLORIS Sw. Nov. Gen. & Sp. Prodr. 25. 1788.

Perennials or annuals, stoloniferous or creeping; leaf blades flat or folded, scabrous; spikes 2-many, aggregated at apex of culm; spikelets sessile, borne in 2 rows along continuous rachis; 1 floret perfect, 1-several florets reduced, often truncate, the glumes unequal, the lower one shorter, narrow, acute, the lemmas keeled, broad, 1-5-nerved, villous or ciliate on keel, awned between short teeth of bifid apex, the sterile lemmas awned or lacking an awn.

LECTOTYPE SPECIES: *Chloris cruciata* (L.) Sw. (*Agrostis cruciata* L.) (ING).

DISTRIBUTION: About forty species, including several useful pasture grasses, distributed in tropical and warm temperate areas. Four introduced species are recorded from Fiji, but only one, *Cynodon inflata*, is common and becoming widespread, especially along roadsides in the dry zone of Viti Levu.

KEY TO SPECIES

Plants stoloniferous, 30-150 cm. tall.

Spikelets 3 mm. or more long; awns 3, 2-3 mm. long (one reduced); lowest lemma elliptic, the upper one oblong-obovate. 1. *C. gayana*

Spikelets plump, purplish when mature, with 3 (rarely 4) awns 6-8 mm. long; second lemma of thinner texture than lowest, much smaller, truncate, obovate, eventually globose. 2. *C. inflata*

Spikelets alike, wedge-shaped, 2-flowered, 2-awned, the awns 8-12 mm. long. 3. *C. truncata*

Plants creeping, 15-30 cm. tall; spikelets narrow, oblong, pale, 2-awned, the awns 4-12 mm. long; a much more delicate grass than the preceding species. 4. *C. divaricata* var. *cynodontoides*

1. *Chloris gayana* Kunth, Rév. Gram. 1: 89, nom. nud. 1829, 293. *t.* 58. 1830; Stapf in This.-Dyer, Fl. Cap. 7: 642. 1900; C. H. Wright in Agr. Circ. Dept. Agr. Fiji 3: 41. 1922; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 20: 15. 1949, in Proc. 7th Pacific Sci. Congr. 5: 238. fig. 4. 1953; J. W. Parham in Dept. Agr. Fiji Bull. 30: 37. fig. 13. pl. III. 1956, Pl. Fiji Isl. 301. 1964, ed. 2. 398. 1972.

Culms 45-150 cm. high, the stolons stout and leafy, the internodes compressed; leaf blades 30-60 cm. long, tapering to a fine point; spikes numerous, up to 16, ascending to erect, 7.5-12 cm. long; spikelets crowded, 2-flowered, brownish cream-colored, the upper glume with an awn 3-4 mm. long, the lower one densely ciliate on margins; lemma 3 mm. long, with awn 1.6-3 mm. long, the upper lemmas usually with awns a little shorter than that of perfect lemma.

TYPIFICATION: The original material came from Senegal, Africa.

DISTRIBUTION: From its source in Africa this species is now grown widely as a forage grass in the warmer regions of the world. It was first introduced into Fiji in 1922 and has been grown under trial many times, but it has not become established, although a few plants are occasionally noted as having escaped from trial plots.

Chloris gayana has been observed in flower in months scattered throughout the year. Seventeen collections are available, all being cited below.

LOCAL NAME AND USE: *Rhodes grass*; it is considered a useful pasture grass.

AVAILABLE COLLECTIONS: VITI LEVU: NANDRONGA & NAVOSA: Agricultural Station, Nathotholevu, Singatoka, DA 8308, 11311, 11852, 12582, 12586. NAITASIRE: Plant Introduction and Quarantine Station, Nanduruloulou, DA 2803, 3619, 3620, 4017, 7397, 8465, 8466, 9053. REWA: Suva wharf, DA 11782. FIJI without further locality, DA 12960, 12963, 12976.

2. *Chloris inflata* Link, Enum. Pl. Hort. Berol. 105. 1821; Greenwood in J. Arnold Arb. 36: 400. 1955; J. W. Parham in Dept. Agr. Fiji Bull. 30: 39. 1956.

Andropogon barbatus sensu L. Mant. Pl. Alt. 302. 1771; non L. 1759.

Chloris radiata sensu B. E. V. Parham in Agr. J. Dept. Agr. Fiji 20: 15. 1949; J. W. Parham in Dept. Agr. Fiji Bull. 30: 38. 1956, Pl. Fiji Isl. 302. 1964; non Sw.

Chloris virgata sensu B. E. V. Parham in Agr. J. Dept. Agr. Fiji 20: 15. 1949; J. W. Parham in Dept. Agr. Fiji Bull. 30: 38. 1956, Pl. Fiji Isl. 302. 1964; non Sw.

Chloris barbata sensu J. W. Parham, Pl. Fiji Isl. 302. 1964, ed. 2. 398. 1972; non Sw.

Annual, tufted grass, the culms and sheaths strongly compressed, 30–90 cm. high; leaf blades lax, 10–30 cm. long, 3–6 mm. broad; spikes usually 10, flexuous, 4–8 cm. long; spikelets crowded, purple-tinged, about 2.5 mm. long, the upper glume mucronate, the lower lemma with an awn 6–8 mm. long, the margins ciliate, the upper lemmas barren, slightly shorter than fertile lemma, the awns slender, 2.5–5 mm. long.

TIPIFICATION: *Chloris inflata* Link is based on material of the annual species that Linnaeus had in hand in 1771; actually, however, *Andropogon barbatus* L. as described in 1759 was a different species, now correctly known as *C. barbata* (L.) Sw. The plant on which Linnaeus's mistaken amplification of 1771 was based was said to be from "India orientalis." This complex situation is well discussed by Fosberg in Taxon 25: 176–178. 1976. The uses of *C. radiata* and *C. virgata* for this grass in Fiji were misidentifications.

DISTRIBUTION: Tropical areas. It was an introduction into Fiji and is now naturalized and becoming common. It occurs from sea level to about 30 m. in open sunny places where earth is compacted. Flowers have been noted from January to July and in November.

LOCAL NAMES AND USE: *Airport grass*, *feather finger grass*, *plush grass*. Although this grass was introduced into Fiji for trials, it has little economic value and is considered a weed of waste places, favoring hard, compacted ground as on roadsides and along the edges of airport runways.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Lautoka, Greenwood 1213. NANDRONGA & NAVOSA: Agricultural Station, Nathotholevu, Singatoka, DA 8309, 9128, 10832. RA: Thamboni, DA 5823, 8117; King's Road, near Thamboni, DA 7158, 7159, 7160. NAITASIRE: Plant Introduction and Quarantine Station, Nanduruloulou, DA 8335, 9167. REWA: Rodwell Road, Suva, DA 2892; Ndelainivesi, DA 9093. VANUA LEVU: THAKAUNDROVE: Savusavu airport, DA 8838, 14305, p. p.

3. *Chloris truncata* R. Br. Prodr. Fl. Nov. Holl. 186. 1810; Summerhayes & Hubbard in Kew Bull. 1927: 42. 1927; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 20: 15. 1949; J. W. Parham in Dept. Agr. Fiji Bull. 30: 38. 1956; Pl. Fiji Isl. 302. 1964, ed. 2. 398. 1972.

Perennial, the culms 30–90 cm. high; spikes 6–10, erect or spreading, 7.5–15 cm. long, digitate; spikelets alike, breaking at maturity, leaving glumes overlapping in 2 rows on one side of slender rachis.

TIPIFICATION: The type material came from New South Wales, Australia.

DISTRIBUTION: Of limited distribution outside Australia; in Fiji it was first col-

lected by Horne. It is not common in Fiji, there being only one specimen in the Fiji Herbarium, and in spite of the earlier Horne collection the species may not really be naturalized; flowers have been noted in November.

LOCAL NAME: *Australian finger grass*.

AVAILABLE COLLECTION: VITI LEVU: REWA: Suva, *C. R. Turbet* 42.

4. *Chloris divaricata* R. Br. var. *cynodontoides* (Balansa) Lazarides in Austral. J. Bot. Suppl. 5: 18. 1972.

Chloris cynodontoides Balansa in Bull. Soc. Bot. France 19: 318. 1872; Summerhayes & Hubbard in Kew Bull. 1927: 43. 1927, in op. cit. 1930: 263. 1930; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 20: 15. 1949; J. W. Parham in Dept. Agr. Fiji Bull. 30: 38. 1956, Pl. Fiji Isl. 301. 1964, ed. 2. 398. 1972. *Chloris divaricata* sensu J. W. Parham in Dept. Agr. Fiji Bull. 30: 39. 1956, Pl. Fiji Isl. 301. 1964, ed. 2. 398. 1972; non R. Br.

Perennial, with culms 15–30 cm. high; sheaths flattened, the leaf blades narrow, flat or convolute, 5–15 cm. long, about 1.5 mm. broad; spikes 4–12 (4–6 on most specimens), slender, 5–15 cm. long; spikelets numerous, not crowded, less than 3 mm. long, 2-awned, the terminal glume empty, linear-lobed, an awn given off from between the lobes.

TIPIFICATION AND NOMENCLATURE: The original material was from New Caledonia. The type of *Chloris divaricata* is from Australia, from either Queensland or the Northern Territory, but the recent treatment of *C. cynodontoides* as a variety, proposed by Lazarides, seems a logical method of treating the taxon.

DISTRIBUTION: An Australian grass, in the broad sense, first recorded from Fiji in 1926. It is naturalized and widespread from sea level to about 30 m. but is nowhere common, occurring in dry hills, along roadsides, and as a weed of cultivation and lawns. Only ten collections are currently at hand, all cited below; flowers have been seen in months scattered throughout the year.

LOCAL NAME AND USE: *Star grass*; it has little or no economic value, being a weed in Fiji.

AVAILABLE COLLECTIONS: VITI LEVU: NANDRONGA & NAVOSA: Singatoka, *Greenwood* 226C. NAITASIRI: Nasinu Training College, *DA* 9117. REWA: Suva, *Greenwood* 226A, *C. R. Turbet* 44, *DA* 8479, 16038; Domain Road, Suva, *DA* 3658; Knollys St., Suva, *DA* 763. KANDAVU: *C. R. Turbet* 8. FIJI without further locality, *DA* 3667. In 1930 Summerhayes and Hubbard reported this taxon from Matuku and Totoya, collected by Dr. and Mrs. Tothill.

14. *LEPTURUS* R. Br. Prodr. Fl. Nov. Holl. 207. 1810.

Perennial, littoral grasses; spikelets 1- or 2-flowered, embedded in the hard rachis and falling attached to the joints; first glume absent except on terminal spikelet, the second glume closing on cavity of rachis and level with surface, hard, nerved, acuminate, longer than joint of rachis, hyaline, shorter than glume, 3-nerved, the palea a little shorter than lemma, hyaline.

TYPE SPECIES: *Lepturus repens* (Forst. f.) R. Br. (*Rottboellia repens* Forst. f.) (ING).

DISTRIBUTION: About 15 species have been recorded, from East Africa and Madagascar to Australia and into Polynesia. Two species are known to occur in Fiji.

KEY TO SPECIES

Leaf blades flat, 3–6 mm. broad; upper glume lanceolate, finely acuminate. 1. *L. repens*
Leaf blades erect, very narrow, inrolled, about 1 mm. broad; upper glume acute. 2. *L. acutiglumis*

1. *Lepturus repens* (Forst. f.) R. Br. Prodr. Fl. Nov. Holl. 207. 1810; Summerhayes & Hubbard in Kew Bull. 1927: 44. 1927, in op. cit. 1930: 264. 1930; J. W. Parham in Dept. Agr. Fiji Bull. 30: 42. fig. 15. 1956, Pl. Fiji Isl. 307. 1964, ed. 2. 405. 1972. FIGURE 72A & B.

Rottboellia repens Forst. f. Fl. Ins. Austr. Prodr. 9. 1786.

Perennial creeping grass, the culms 20–60 cm. high; leaf blades 7.5–15 cm. long, 3–6 mm. broad, glaucous; spikelets solitary, the lower one perfect, partly embedded in the hollows of the rachis of spike, this solitary, terminal, jointed, straight, erect, 5–15 cm. or more long.

TIPIFICATION: Forster mentions his new species as from "Insulae intra tropicos."

DISTRIBUTION: From Ceylon, Malesia, and Australia into Polynesia. In Fiji it was first collected by Greenwood in 1919, but it is obviously well established, being known from sandy areas in many parts of the archipelago. It occurs at sea level, on sandy shores, beaches, and sometimes on rocky shores. Flowers have been observed between May and June. About a dozen specimens are at hand, all cited below.

USE: No local names have been recorded in Fiji, but the plant has runners and a well developed root system which serve to make it a good sand binder.

AVAILABLE COLLECTIONS: VITI LEVU: NADRONGA & NAVOSA: Sovi Bay, DA 17434. TAILEVU: Ndawasama, DA 3016. KANDAVU: C. R. Turbet 27. OVALAU: Vicinity of Thawathi, Smith 8102. NGAU: Shore of Herald Bay in vicinity of Sawaieke, Smith 7938. VANUA LEVU: MATHUATA: Along coast, Greenwood 224A. TAVEUNI: Opposite Waitavala Estate, DA 16899. Fiji without further locality, DA s. n., 3533, 3534, 3535. Summerhayes and Hubbard gave many more localities for this grass, indicating that it is more frequent than here indicated. Dr. and Mrs. Tothill obtained it from the islands of Vatulele, Mbatiki, Koro, Tomberua (off Mbua coast, Vanua Levu), Totoya, Matuku, Kanathea, Vanua Mbalavu, Mango, Nayau, Kambara, and Fulanga.

2. *Lepturus acutiglumis* Steudel, Syn. Pl. Glum. 2: 357. 1855; J. W. Parham, Pl. Fiji Isl. ed. 2. 405. 1972. FIGURE 72C & D.

Perennial, the culms 20–30 cm. high; leaf blades narrow, glaucous, erect, 5–15 cm. long, about 1 mm. broad, inrolled; spike terete; spikelets about 4 mm. long, embedded in internodes of rachis, the upper glume single-nerved, acute, about 8 mm. long, almost twice as long as the internode; rudiment of second floret virtually absent.

TIPIFICATION: The type of Steudel's species was collected by Dumont d'Urville in Tahiti.

DISTRIBUTION: Pacific Islands, at scattered localities. The only Fijian record is the one cited below, obtained by Margaret E. Parham in flower in December, 1967. Perhaps it is more frequent than assumed at present.

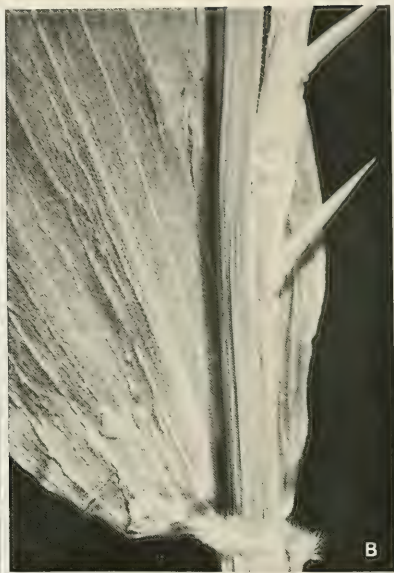
AVAILABLE COLLECTION: VANUA LEVU: MATHUATA: Nakuthi Island (off coast opposite mouth of Ndreketi River), DA 15284.

15. *AVENA* L. Sp. Pl. 79. 1753, Gen. Pl. ed. 5. 34. 1754.

Annuals or perennials; panicles narrow or open, usually few-flowered with large spikelets, 2–several-flowered, the rachilla bearded, disarticulating above glumes and between florets, the glumes approximately equal, several-nerved, the lemmas 5–9-nerved, with a twisted dorsal awn.

LECTOTYPE SPECIES: *Avena sativa* L. (ING).

DISTRIBUTION: About 70 species, mostly from temperate climates or from mountains in the tropics. The commonly cultivated species, *Avena sativa*, is perhaps



derived from some wild form such as *A. fatua* L. It has been noted as an occasional escape in Fiji.

1. *Avena sativa* L. Sp. Pl. 79. 1753; B.E.V. Parham in Agr. J. Dept. Agr. Fiji **20**: 15. 1949; J.W. Parham in Dept. Agr. Fiji Bull. **30**: 48. 1956, Pl. Fiji Isl. ed. 2. 396. 1972.

TYPIFICATION: Linnaeus's material doubtless came from European cultivated plants.

DISTRIBUTION: Temperate regions throughout the world. This important cereal is not cultivated in Fiji but it is occasionally noted as an escape. Flowering specimens have been recorded in January and November.

LOCAL NAMES AND USE: *Oats*; *jai* (Hindi). Although this cereal is of great economic importance, it does not thrive in Fiji but may be found as a non-persistent adventive.

AVAILABLE COLLECTIONS: VITI LEVU: TAILEVU: Near sugar mill, Nausori, DA 2414. REWA: Suva wharf, DA 11783. FIJI without further locality, DA 3652, 3657.

16. *AMMOPHILA* Host, Gram. Austr. **4**: 24. 1809.

Perennials, erect, coarse and tough with scaly, creeping rhizomes; leaf blades long, involute; panicles spikelike; spikelets 1-flowered, the rachilla disarticulating above glumes, these approximately equal, the lemma similar to but shorter than glumes; palea about same length as lemma.

TYPE SPECIES: *Ammophila arundinacea* Host, nom. illeg. (*Arundo arenaria* L.: *Ammophila arenaria* (L.) Link) (ING).

DISTRIBUTION: A genus of two species in Atlantic North America, Europe, and northern Africa. One species, *Ammophila arenaria*, was introduced into Fiji in 1947 for trial and has become established but has failed to spread.

1. *Ammophila arenaria* (L.) Link, Enum. Hort. Pl. Berol. 105. 1821; B.E.V. Parham in Agr. J. Dept. Agr. Fiji **20**: 15. 1949; J.W. Parham in Dept. Agr. Fiji Bull. **30**: 49. 1956, Pl. Fiji Isl. 299. 1964, ed. 2. 395. 1972.

Arundo arenaria L. Sp. Pl. 82. 1753.

Perennial, with culms 50–150 cm. high; leaf blades 1.2–1.3 m. long, 4–6 mm. broad, firm, soon becoming involute, tapering to a point, the upper surface puberulent, the margins scabrous; panicle spikelike.

TYPIFICATION: Linnaeus gave several prior references and doubtless based his species on European material.

DISTRIBUTION: From Europe the species was introduced into the United States as a sand binder for coastal dunes. For the same purpose it was tried in Fiji in 1947 but has become only very locally established.

LOCAL NAMES AND USE: *Marram grass*, *European beach grass*. As indicated, the species is considered useful for increasing the stability of sand dunes.

AVAILABLE COLLECTION: VITI LEVU: NANDRONGA & NAVOSA: Thuvu sand hills, near Singatoka, DA 17326.

FIGURE 72. A & B, *Lepturus repens*, from Smith 8102; A, apical portion of plant and inflorescence, $\times 1/2$; B, detail of leaf base subtending an inflorescence, $\times 8$. C & D, *Lepturus acutiglumis*, from DA 15284; C, apical portion of plant, $\times 1/2$; D, detail of stem and leaf base, $\times 8$.

17. *GARNOTIA* Brongn. in Duperrey, Voy. Coquille Bot.-Phan. 132. 1832.

Erect, mostly perennial grasses; leaf blades narrow, acuminate or acute; inflorescence a loose or contracted panicle; spikelets disarticulating below glumes and falling entire; spikelets 1-flowered, the glumes as long as spikelet, usually lacking an awn, the lemma awned.

TYPE SPECIES: *Garnotia stricta* Brongn. (ING).

DISTRIBUTION: The number of species of *Garnotia* has been a matter of opinion; in the two recent revisions cited below, Santos (1950) has recognized 73 species, 46 varieties, and 24 forms, whereas Gould (1972) interprets the genus as comprising 29 species, some with infraspecific divisions. The genus ranges from the Seychelles to India and southern China, eastward to northern Australia, and into Polynesia. Most early collections were referred to the type species, *G. stricta*, and the interpretations of this have been confusing. Santos limits it to Tahiti (the type locality) and Guam, but Gould believes it to be composed of two varieties which occur from the Philippines and Micronesia to New Guinea and Queensland, with an outlying population in Tahiti. *Garnotia stricta* is believed not to occur in Fiji, where five species, all endemic, are now recognized. In 1964 (Pl. Fiji Isl. 305) I erroneously listed *G. mucronata* Swallen, which is typified by a collection from Raiatea; Gould considers this a synonym of *G. depressa* J. W. Moore.

USEFUL TREATMENTS OF GENUS: Santos, J. V. A revision of the grass genus *Garnotia*. Nat. Appl. Sci. Bull. Univ. Philipp. 10: 3-179. 1950. Gould, F. W. A systematic treatment of *Garnotia* (Gramineae). Kew Bull. 27: 515-562. 1972.

KEY TO SPECIES

- Leaf blades up to 12 cm. long and 2.5 mm. broad; panicle branches stiffly spreading, about 2.5 cm. long; awns 1-3 mm. long. 1. *G. divergens*
 Leaf blades reflexed or stiffly spreading, acuminate, 3-6 cm. long, about 2 mm. broad; panicle branches 2-3 cm. long; awns 4.5-8.5 mm. long. 2. *G. gracilis*
 Leaf blades 6-15 cm. long, 3-5 mm. broad; panicle branches appressed, 2-4.5 cm. long; awns slender, flexuous, 6-10 mm. long. 3. *G. linearis*
 Leaf blades purple-tinged, 5-15 cm. long, 6-8 mm. broad, the margins scabrous; sheaths purplish in color; awns 1.5-7.5 mm. long. 4. *G. foliosa*
 Leaf blades erect, broad, 10-15 cm. long, 6-12 mm. broad; sheaths densely villose; panicle branches about 7 cm. long; spikelets 2.5-5 mm. long, the lemma with awn about 3 mm. long or lacking awn. 5. *G. villosa*

1. *Garnotia divergens* Swallen in J. Arnold Arb. 31: 143. 1950; J. W. Parham in Dept. Agr. Fiji Bull. 30: 59. 1956, Pl. Fiji Isl. 305. 1964, ed. 2. 403. 1972; Gould in Kew Bull. 27: 549. 1972.

Perennial, the culms slender, glabrous, 35-40 cm. high; panicle 4-8 cm. long; spikelet 3 mm. long, the glumes acute, unequal; lemma with awn 1-3 mm. long.

TIPIFICATION: The holotype is *Smith 6519* (US), collected Nov. 6, 1947, in flower, at an altitude of 500-590 m. on the summit ridge of Mt. Numbuiloa, east of Lam-basa, Mathuata Province, Vanua Levu.

DISTRIBUTION: Endemic to Fiji and known only from the type collection, which was observed forming dense mats in dense forest; there are several isotypes.

2. *Garnotia gracilis* Swallen in J. Arnold Arb. 31: 142. 1950; J. W. Parham in Dept. Agr. Fiji Bull. 30: 59. 1956, Pl. Fiji Isl. 305. 1964, ed. 2. 403. 1972; Gould in Kew Bull. 27: 548. 1972. FIGURE 73A.

Garnotia stricta sensu Summerhayes & Hubbard in Kew Bull. 1927: 41. 1927; J. W. Parham in Dept. Agr. Fiji Bull. 30: 59. 1956, Pl. Fiji Isl. 305. 1964.

Perennial, the culms slender, branching, glabrous, 18–36 cm. high; leaf blades reflexed or stiffly spreading; panicle narrow, long-exserted, 3–8 cm. long; spikelets about 3.5 mm. long, the glume nerves scabrous; awns 4.5–8.5 mm. long.

TYPIFICATION: The holotype is *Smith 4413* (US), collected May 14, 1947, at an altitude of 1,050 m. on the slopes of Mt. Nairosa, eastern flank of Mt. Evans Range, in dense mats on an open summit at the base of the ultimate pinnacle, Mba Province, Viti Levu. There are several isotypes.

DISTRIBUTION: Endemic to Fiji and known with certainty only from the Mt. Evans Range of northwestern Viti Levu, where it occurs at elevations of 700–1,050 m. on open ridges and summits, on boulders on reed-covered hillsides, and on moist rocks, sometimes forming dense mats. Flowers have been observed in April and May.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Northern portion of Mt. Evans Range between Mt. Vatuyanitu and Mt. Natondra, *Smith 4338*; Lower falls, Mt. Evans Range, *Greenwood 225*; Natualevu, Mt. Evans Range, *DA 14183*. FIJI without further locality, *DA 3274*.



FIGURE 73. A, *Garnotia gracilis*, portion of inflorescence, $\times 4$, from *Smith 4413*; B, *Garnotia linearis*, mid-portions of two inflorescences, $\times 4$, from *Degener 15053*. C, *Microlaena avenacea*, terminal portion of inflorescence, $\times 4$, from *Gillespie 4106*.

3. *Garnotia linearis* Swallen in J. Arnold Arb. 31: 143. 1950; J. W. Parham in Dept. Agr. Fiji Bull. 30: 59. 1956, Pl. Fiji Isl. 305. 1964, ed. 2. 403. 1972; Gould in Kew Bull. 27: 554. 1972. FIGURE 73B.

Garnotia munroana Santos in Nat. Appl. Sci. Bull. Univ. Philipp. 10: 64. 1950; J. W. Parham, Pl. Fiji Isl. ed. 2. 403. 1972.

Garnotia solitaria Santos in Nat. Appl. Sci. Bull. Univ. Philipp. 10: 95. 1950; J. W. Parham, Pl. Fiji Isl. ed. 2. 403. 1972.

Perennial, the culms erect or ascending, 38–60 cm. high; panicle 10–18 cm. long; spikelets about 4.5 mm. long, borne on short pedicels; awns 6–10 mm. long.

TYPIFICATION AND NOMENCLATURE: The holotype of Swallen's species is *DA 2964* (coll. B. E. V. Parham) (GH; ISOTYPES at K, SUVA, US), collected near Ndaku Village, Kandavu. Santos was unaware of Swallen's work in his later publication of the same year. The holotype of *G. munroana* is *U.S. Expl. Exped.* (US 999376; ISOTYPES at GH, US 746739), collected in Fiji in 1840 without further locality. The holotype of *G. solitaria* is *Degener 15053* (GH; ISOTYPES at BISH, K, NY, UC, US), collected April 22–May 7, 1941, at an elevation of about 150 m. on Mt. Nggamu, near Ngaloa, Serua Province, Viti Levu.

DISTRIBUTION: Endemic to Fiji, and known only from the three type collections mentioned above and two others, presumably obtained at elevations of sea level to 150 m. Flowers have been observed with certainty only during April and May.

AVAILABLE COLLECTIONS: KANDAVU: *DA 8981*. VANUA LEVU: *Greenwood 549A*, ex Gould.

4. *Garnotia foliosa* Swallen in J. Arnold Arb. 31: 142. 1950; J. W. Parham, Pl. Fiji Isl. 305. 1964, ed. 2. 403. 1972; Gould in Kew Bull. 27: 550. 1972.

Perennial, the culms erect, densely tufted, 48–85 cm. high; panicle long-exserted, 6–10 cm. long, the branches appressed, 1–3 cm. long; spikelets 4–4.5 mm. long, borne on short pedicels, the glume with scabrous nerves; awns 1.5–7.5 mm. long.

TYPIFICATION: The holotype is *Smith 6520* (US), collected Nov. 6, 1947, in dense crest forest of the summit ridge of Mt. Numbuloa, alt. 500–590 m., east of Lambasa, Mathuata Province, Vanua Levu. Several isotypes are available.

DISTRIBUTION: Known only from the type and one other collection from Vanua Levu, on mountain slopes or in dense crest forest at 500–800 m. Flowers have been observed in July and November.

AVAILABLE COLLECTION: VANUA LEVU: MATHUATA-THAKAUNDROVE boundary: Mt. Ndelaikoro, *DA 13427*.

5. *Garnotia villosa* Swallen in J. Arnold Arb. 31: 143. 1950; J. W. Parham in Dept. Agr. Fiji Bull. 30: 59. *fig. 21*. 1956, Pl. Fiji Isl. 306. 1964, ed. 2. 403. 1972; Gould in Kew Bull. 27: 549. 1972.

Perennial, the culms erect, fibrous, 30–50 cm. high; sheaths pubescent; panicle erect, lax, 10–15 cm. long; spikelets 2.5–5 mm. long, light cream-colored, the glumes and lemma acuminate, the lemma with short awn about 3 mm. long.

TYPIFICATION: The holotype is *DA 2162* (coll. B. E. V. Parham) (GH; ISOTYPE at SUVA), collected on rocky cliffs in the Korombasambasanga Range, alt. 1,067 m., Namosi Province, Viti Levu. The specimen was in flower in March.

DISTRIBUTION: Endemic to Fiji and thus far known only from the type collection.

18. *ARISTIDA* L. Sp. Pl. 82. 1753, Gen. Pl. ed. 5. 35. 1754.

Annual or perennial tufted herbs; leaf blades narrow, often convolute; inflorescence a panicle; spikelets pedicellate, all alike, hermaphrodite, 1-flowered, the

rachilla disarticulating above glumes, these usually persistent, 1-3-nerved, sometimes awned; lemma awned; palea small, oblong, 2-nerved.

TYPE SPECIES: *Aristida adscensionis* L., the only species of the genus described in *Species Plantarum*. (ING).

DISTRIBUTION: Temperate and subtropical regions of the world, with approximately 330 species. One species has been recorded in Fiji.

1. *Aristida ramosa* R. Br. Prodr. Fl. Nov. Holl. 173. 1810.

Aristida aspera sensu A. C. Sm. in Sargentia 1: 6. 1942; J. W. Parham, Pl. Fiji Isl. 300. 1964, ed. 2. 395. 1972; non Swallen.

Perennial, the culms in dense, hard clumps, erect from short, knotty rhizomes, 40-60 cm. tall, somewhat flattened, branching from nodes, the branches often in fascicles; sheaths much shorter than elongate internodes, scaberulous; leaf blades becoming involute, especially toward tip, 6-20 cm. long, 0.5-1.5 mm. broad; panicles 8-15 cm. long, the branches rather distant, occasionally overlapping, few-flowered, appressed; spikelets appressed to somewhat spreading, the pedicels 3-7 mm. long; awns trifid, 10-15 mm. long, terete, scabrous, equally spreading.

TIPIFICATION AND NOMENCLATURE: The original locality of Brown's species is "Apud Portum Jackson, inclusis ripis aestuarii Hunter's river vel Coal river," Australia. *Aristida aspera* Swallen (in J. Wash. Acad. Sci. 26: 177. 1936) is based on a plant from Rapa, which differs in several important respects from the Fijian plant referred to it by Smith on the basis of Agnes Chase's identification.

DISTRIBUTION: Australia; in Fiji it is known with certainty only from Makondronga Island in Loma-i-Viti, where it was found growing on a dry, forested slope at 60 m. Flowers have been observed in November and December.

AVAILABLE COLLECTIONS: MAKONDONGA: *Degener & Ordonez 13810*. FIJI without further locality, *DA 3274*.

19. *Zoysia* Willd. in Ges. Naturf. Freunde Berlin Neue Schriften 3: 440. 1801. Nom. cons.

Perennials, with creeping rhizomes; leaf blades pointed; racemes spike-like, terminal; spikelets short-pedicellate, 1-flowered, laterally compressed, appressed against slender rachis, glabrous, disarticulating below glumes, the first glume absent, the second glume mucronate or short-awned.

TYPE SPECIES: *Zoysia pungens* Willd. (ING).

DISTRIBUTION: Usually considered to be composed of ten species distributed from the Mascarene Islands to New Zealand. A single introduced species occurs in Fiji.

1. *Zoysia japonica* Steudel, Syn. Pl. Glum. 1: 414. 1854; J. W. Parham in Dept. Agr. Fiji Bull. 30: 35. 1956, Pl. Fiji Isl. 312. 1964, ed. 2. 413. 1972.

Perennial; leaf blades flat, dark green, somewhat stiff, 12-18 mm. long, 2.5-3 mm. broad.

TIPIFICATION: The original material was from Japan.

DISTRIBUTION: Introduced into Fiji about 1952 as a lawn grass, but cultivated for that purpose only on a small scale.

LOCAL NAME AND USE: *Korean lawn grass*. As suggested, this species is favored for lawns in many tropical and subtropical areas, but in Fiji its use seems very limited.

AVAILABLE COLLECTION: VITI LEVU: REWA: Department of Agriculture grounds, Suva, *DA 10058*.

20. *MICROLAENA* R. Br. Prodr. Fl. Nov. Holl. 210. 1810.

Annuals or perennials, the culms erect; panicle erect, open or contracted; spikelets solitary, pedicellate, laterally compressed, falling away from the very small, persistent glumes; lemmas 3, the lower 2 empty, narrow, tapering to a slender, terminal awn, the upper one much shorter, enclosing a perfect flower, acute or shortly l-awned.

TYPE SPECIES: *Microlaena stipoides* (Labill.) R. Br. (*Ehrharta stipoides* Labill.) (ING).

DISTRIBUTION: Philippine Islands and Java to Australia and New Zealand; about ten species are recognized.

1. *Microlaena avenacea* (Raoul) Hook. f. Handb. New Zeal. Fl. 320. 1864; J. W. Parham, Pl. Fiji Isl. ed. 2. 405. 1972. FIGURE 73C.

Diplax avenacea Raoul, Choix Pl. Nouv.-Zél. 2. t. 3. 1846.

TYPIFICATION: The original material came from Akaroa, New Zealand.

DISTRIBUTION: New Zealand. In Fiji it has been established for a number of years, since the Gillespie specimen cited below was collected in 1927 and the DA specimens in 1946. It occurs in Fiji only on Mt. Tomanivi (Mt. Victoria), at elevations of 1,000-1,300 m.; the suggestion has been made that it was accidentally introduced from New Zealand by timber cutters who helped establish the timber industry in the area. Flowers have been noted in September and November.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Near summit and on upper slopes of Mt. Tomanivi, Gillespie 4106, DA 3268, 3269.

21. *ORYZA* L. Sp. Pl. 333. 1753, Gen. Pl. ed. 5. 155. 1754.

Annual, sometimes perennial swamp grasses; leaf blades flat; panicle open; spikelets 1-flowered, laterally compressed, disarticulating below glumes; glumes markedly shorter than lemma, narrow, the lemmas keeled, 5-nerved, sometimes awned; palea narrower than lemma, keeled, 2-nerved close to margin.

TYPE SPECIES: *Oryza sativa* L., the only species mentioned in *Species Plantarum*, ed. 1. (ING).

DISTRIBUTION: About 25 species in tropical countries. Rice, *Oryza sativa*, is widely grown in Fiji.

1. *Oryza sativa* L. Sp. Pl. 333. 1753; Summerhayes & Hubbard in Kew Bull. 1927: 40. 1927; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 20: 18. 1949; J. W. Parham in Dept. Agr. Fiji Bull. 30: 49. 1956, Pl. Fiji Isl. 307. 1964, ed. 2. 406. 1972.

Annual, the culms erect, 90-180 cm. or more high; leaf blades elongate, narrow, 30-60 cm. long, 3-6 mm. broad; panicle dense, drooping, especially near maturity, 15-40 cm. long; spikelets 6-8 mm. long, the lemma mucronate, sometimes with an awn.

TYPIFICATION: Linnaeus gave several prior references and then noted: "*Habitat forte in Aethiopia, colitur in Indiae paludosis.*"

DISTRIBUTION: Presumably originally from Africa or India, *Oryza sativa* is now widely cultivated throughout the tropics, being one of the world's chief food plants. It was introduced into Fiji about 1902 and is now widely cultivated, both wet and dry land cultivars being grown. The flowering season is normally in March and April.

LOCAL NAMES AND USE: *Rice; dhan* (Hindi). This species is of course a very important cereal in Fiji. There are many local cultivar names in use, and extensive re-

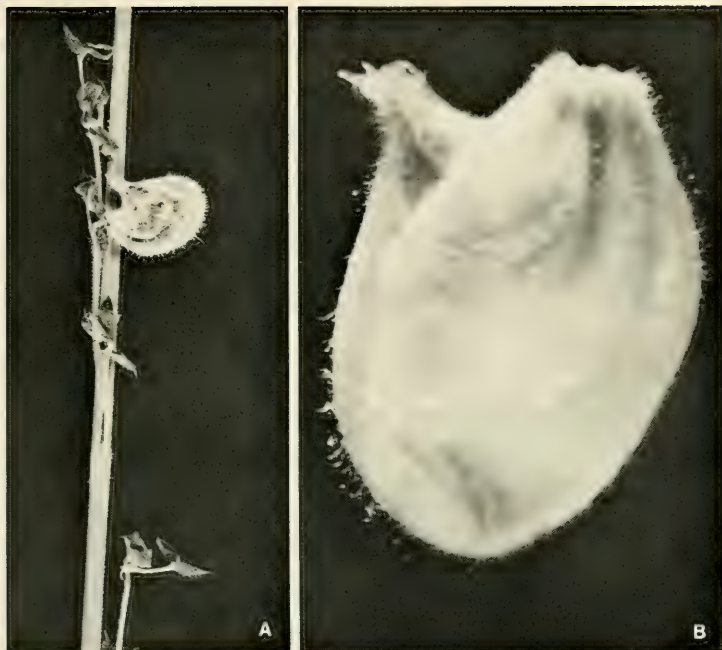


FIGURE 74. *Leptaspis angustifolia*, from Smith 6583; A, portion of inflorescence, $\times 4$; B, floret enclosed in saclike lemma, $\times 20$.

search on new cultivars is carried out at the Koronivia Research Station (Naitasiri Province), across the Rewa River from Nausori.

AVAILABLE COLLECTIONS: VITI LEVU: SERUA: Navua, DA 2855. NAITASIRI: Nanduruloulou, DA 3527, 3528, 3530, 3531. REWA: Ndevi area, DA 1500; Rewa, DA 1504; Vuninokonoko, DA 2855, 2856. VANUA LEVU: MBUA: DA 3529.

22. LEPTASPIS R. Br. Prodr. Fl. Nov. Holl. 211. 1810.

Perennial herbs; leaf blades flat, broad, obovate or oblanceolate, narrowed to a short, petiolelike base; panicle narrow, few-flowered, the branches appressed, often bearing a few ♀ spikelets at base and 1 or more ♂ spikelets terminally; spikelets 1-flowered, unisexual, the ♀ spikelets terete, with glumes present, unequal, open down one side or closed except for a pore at side or top; ♂ spikelets smaller, the glumes small, ovate, empty, 5–7-nerved.

TYPE SPECIES: *Leptaspis banksii* R. Br. (ING).

DISTRIBUTION: Five species are usually recognized, occurring in tropical West Africa, the Mascarene Islands, Ceylon, and Fiji, where one species is endemic.

1. *Leptaspis angustifolia* Summerhayes & Hubbard in Kew Bull. **1927**: 40, 78. 1927; Swallen in J. Arnold Arb. **31**: 144. 1950; J. W. Parham in Dept. Agr. Fiji Bull. **30**: 50. fig. 18. 1956, Pl. Fiji Isl. 307. 1964, ed. 2. 405. 1972. FIGURE 74.

Perennial, densely tufted, 45–60 cm. high; leaf blades erect to slightly spreading, fairly rigid, narrow, dark green, 15–45 cm. long, 3–9 mm. broad, pointed, rough on both surfaces, the veins fine, the cross nerves visible; panicle erect, very narrow, 10–20 cm. long, the branches 10–25 mm. long; spikelets black, about 2.5 mm. long.

TIPIFICATION: The holotype is *Greenwood 550* (κ), collected at an elevation of about 80 m. in hills near Lambasa, Mathuata Province, Vanua Levu.

DISTRIBUTION: This interesting Fijian endemic is known only from the mountains and hills of Mathuata Province, occurring at elevations of 30–500 m. Apparently it is not uncommon on steep rocky slopes in open forest and in the forest of low ridges; nevertheless collections are few. Flowers have been noted in April, October, and November.

AVAILABLE COLLECTIONS: VANUA LEVU: MATHUATA: Nasuvu, near Lambasa, *DA 1506, 2413*; southern slopes of Mt. Numbulua, east of Lambasa, *Smith 6583*; between Ndoloko and Ndranombamba, *DA L.15333* (*E. Damanu s. n.*). FIJI without further locality, *DA 3254, 3653*.

23. DIGITARIA Heister ex Fabric. Enum. Meth. Pl. 207. 1759.

Annuals or perennials, erect or prostrate grasses, often with runners or stolons; culms bearing slender racemes digitate or approximate; spikelets in twos or threes, very occasionally solitary, subsessile or short-pedicellate, lanceolate or elliptic, the first glume equal to or shorter than the sterile lemma.

TYPE SPECIES: The ING cards do not yet indicate a type or lectotype species.

DISTRIBUTION: A large genus, probably of nearly 400 species, found throughout the warmer regions of the world. Twelve species have been recorded from Fiji, of which I account for only nine in the following treatment, these being naturalized or cultivated. The following three species have been grown under trial as pasture grasses but none of them will be found outside of trial plots. *Digitaria exilis* (Kipist) Stapf (cf. J. W. Parham in Fiji Dept. Agr. Bull. **30**: 97. 1956) was introduced in 1950 (as *FDA 13405*) for trial at the Plant Introduction and Quarantine Station, Nanduruloulou, Naitasiri Province (represented by *DA 3171*); it was later abandoned as being unsuitable. *Digitaria pentzii* Stent (represented by *DA 13191* from the Mba Closed Area introduction plots, Mba Province) and *D. smutsii* Stent (plant introduction *FDA 15430*, represented in the herbarium by *DA 12968*, without detailed information) were brought into Fiji for trial in 1970 and show some promise, but at this point they have not been distributed nor become in any way naturalized.

USEFUL TREATMENTS OF GENUS: Henrard, J. T. Monograph of the genus *Digitaria*. 1–XXI. 1–999. 1950. Blake, S. T. *Digitaria* (in Taxonomic and nomenclatural studies in the Gramineae, No. 2) in Proc. Roy. Soc. Queensland **81**: 7–20. 1969.

KEY TO SPECIES

Stems creeping, sending up erect flowering culms; racemes given off from apex of culm or from very close to apex.

Racemes usually 3, 2.5–5 cm. long, the rachis broadly winged; nerves on lower lemma very prominent, giving a ribbed appearance; not common. 1. *D. didactyla*

Racemes usually 2, sometimes 3, 3–6 cm. long; spikelets glabrous, the upper glume 3–5-nerved, the lemma as long as upper glume, 5-nerved, the purplish blue tip of second lemma protruding; common. 2. *D. fuscescens*

Stems not creeping; erect grasses, sometimes stoloniferous and rooting at nodes; racemes given off from apex of culm and from below apex.

- Racemes 2-5, 2.5-6 cm. long; upper glume markedly 3-nerved, the margin and nerves glabrous; not common. 3. *D. caledonica*
- Racemes 2-5, erect, 2.5-6 cm. long; upper glume 5-nerved, the margin and nerves ciliate; common. 4. *D. violascens*
- Racemes 2 or 3, 5-10 cm. long; spikelets sparsely pubescent; lower glume reduced to a triangular scale, the upper glume about half as long as spikelet, 3-nerved, shortly hairy between nerves and along margins; moderately common. 5. *D. radicata*
- Racemes 6-12, erect, 10-15 cm. long; spikelets ciliate along margins; lower glume reduced, glabrous, the upper glume 5-nerved, more than half length of spikelet, densely pubescent; not common. 6. *D. milaniana*
- Racemes 5-7, 5-10 cm. long; spikelets almost glabrous; upper glume 5-nerved; occasionally cultivated. 7. *D. decumbens*
- Racemes 4-9, ascending, 5-15 cm. long; spikelets pubescent along margins; lower glume small, triangular, glabrous, the upper glume half as long as spikelet or longer, 3-nerved, the margins ciliate, the lower lemma 5-7-nerved; common. 8. *D. ciliaris*
- Racemes usually 6-12, 7.5-15 cm. long; spikelets sparsely pubescent on margins; lower glume absent or much reduced, the upper glume not more than one-fourth length of spikelet, sparsely pubescent, the lemmas as long as spikelet; common. 9. *D. setigera*

1. *Digitaria didactyla* Willd. Enum. Pl. Hort. Berol. 91. 1809; J. W. Parham, Pl. Fiji Isl. ed. 2. 400. 1972.

Small, creeping grass; leaf blades narrow, pointed, 2-3 cm. long, 1-2 mm. broad; racemes usually 3; spikelets 2-3 mm. long.

TIPIFICATION: The original citation is "Habitat in Insula Borboniae, Bory de St. Vincent." The type locality is therefore the Mascarene Islands.

DISTRIBUTION: Madagascar, Mascarene Islands, Australia, and New Guinea. In Fiji it is rare, being known only from Naitamba Island in the Lau Group and in Suva. At sea level it has been noted in flower in January.

USE: *Digitaria didactyla* is considered to be a very good lawn grass in well-drained situations in Australia and at higher altitudes in New Guinea.

AVAILABLE COLLECTIONS: VITI LEVU: REWA: Suva Golf Club, DA 17195; botany laboratory garden, grown from plants of the following. NAITAMBA: DA 11230.

2. *Digitaria fuscescens* (Presl) Henrard in Meded. Rijks-Herb. 61: 8. 1930; Swallen in J. Arnold Arb. 31: 141. 1950; J. W. Parham, Pl. Fiji Isl. 303. 1964, ed. 2. 400. 1972.

Paspalum fuscescens Presl, Rel. Haenk. 1: 213. 1830.

Digitaria longiflora sensu Summerhayes & Hubbard in Kew Bull. 1927: 31. 1927, in op. cit. 1930: 255. 1930; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 20: 16. 1949, in Proc. 7th Pacific Sci. Congr. 5: 236. 1953; J. W. Parham in Dept. Agr. Fiji Bull. 30: 94. fig. 39. 1956, in op. cit. 35: 167. 1959, Pl. Fiji Isl. 303. 1964; non Presl.

Perennial, the culms widely creeping; leaf blades and sheath glabrous, the blades flat, 1-3 cm. long, about 2.5 mm. broad; culms ascending to 10-40 cm.; racemes usually 2, sometimes 3, curved, 3-6 cm. long; spikelets glabrous, 1-1.5 mm. long.

TIPIFICATION: Although the holotype, collected by Haenke, is indicated by Presl to have been from Peru (but in his "Corrigenda" changed to California), Henrard thinks that Haenke's material actually came from the Philippines. The Haenke labels were notoriously confused as to some localities.

DISTRIBUTION: This grass is known to occur in eastern India, Burma, Malesia, and the Philippines. Presumably it was accidentally introduced into Fiji, where it is now widespread from sea level to 970 m. It is a weed of cultivation, found along roadsides, in waste places, on open hillsides, and on sandy flats above beaches; it also occurs in dry forest, forming mats in open places, and it has become naturalized

along forest trails. It is very common in *talasinga* areas, where it is one of the few grasses that will volunteer in the poor soils. It has been recorded in flower throughout the year. I have seen about 30 Fijian collections, but there are certainly more than this in various herbaria.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Vakambuli, near Lautoka, *DA 8238*; Government Station, Mba, *DA 8192*; Mt. Ndelaithathovu, on escarpment west of Nandarivatu, *Smith 4953*; Nandarivatu, *DA 2100*. SERUA: Vicinity of Ngaloa, *Smith 9615*; hills near Taunovo Creek, east of Wainiyambia, *Smith 9601*. RA: Nanokonoko, *DA 7883*; Rakiraki, *DA 7926*. NAITASIRI: Tamavua, *DA 3582*; Koronivia, *DA 3963*; Nanduna, *DA 2404*. KANDAVU: Ngaloa Island, *DA 9073*. OVALAU: Wainaloka, *DA 1362*. VANUA LEVU: MATHUATA: District Farm Northern, Seanggangga area, *DA L.15609*; near Ndaku, Lambasa, *DA 8791*; Nakoroutari, *DA 11771*. Summerhayes and Hubbard also recorded collections from the islands of Moturiki, Koro, Mbatiki, Ngau, Moala, Totoya, Matuku, Vanua Mbalavu, and Mango.

3. *Digitaria caledonica* Henrard in *Blumea* 1: 100. 1934; J. W. Parham in *Dept. Agr. Fiji Bull.* 30: 98. 1956, in op. cit. 35: 167. 1959, *Pl. Fiji Isl.* 303. 1964, ed. 2. 400. 1972.

Culms tufted, up to 40 cm. high; leaf blades linear-lanceolate, 10–12 cm. long, about 5 mm. broad, the ligule hyaline, 1–1.5 mm. long, lacking hairs at junction of blade and sheath.

TIPIFICATION: The holotype is *Balansa 1730* (L), collected in New Caledonia.

DISTRIBUTION: New Caledonia; in Fiji it is recorded from introduction plots and is probably not, or only very sparsely, naturalized. *Digitaria caledonica* is superficially very similar in appearance to *D. violascens*. Flowers have been noted between March and May.

AVAILABLE COLLECTIONS: VITI LEVU: RA: District Farm, Ndombuilevu, *DA 7850, 7864*. NAITASIRI: Plant Introduction and Quarantine Station, Nanduruloulou, *DA 7600*.

4. *Digitaria violascens* Link, *Enum. Pl. Hort. Berol.* 229. 1827; Swallen in J. Arnold *Arb.* 31: 141. 1950; J. W. Parham in *Dept. Agr. Fiji Bull.* 30: 98. 1956, *Pl. Fiji Isl.* 304. 1964, ed. 2. 401. 1972.

Annual or sometimes perennial, the culms tufted, 30–50 cm. high; leaves mostly clustered near base, the blades flat, 3.7–7.5 cm. long, 3–6 mm. broad, the ligule chartaceous, 1–3 mm. long; ciliate hairs present at junction of blade and sheath.

TIPIFICATION: The species was described from cultivated plants raised in Berlin from seeds received from Brazil; the type taken from this material was deposited at B.

DISTRIBUTION: *Digitaria violascens* is native in China, India, and Australia, but apparently it has been widely naturalized in the American tropics for considerable time. In Fiji it is common on riverbanks and along the inner edges of mangrove swamps, on hillsides, in cultivation, and along roadsides. I have seen only about 20 collections, but no doubt the plant is more common than this implies. Flowers have been noted throughout the year.

LOCAL NAME AND USES: *Crab grass*. It is reported to be able to withstand heavy grazing, although nowhere in Fiji does it form anything like pure stands; in fact it is regarded as a weed of cultivation rather than a valuable pasture grass.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Lautoka, *Greenwood 185*; Sambeto Valley, *DA 8270*. SERUA: Tokotoko road, Navua, *DA 8654*. RA: Rewasa, *DA 8090*. NAITASIRI: Vinundawa, *DA 7794*; Research Station, Koronivia, *DA 4004*; Plant Introduction and Quarantine Station, Nanduruloulou, *DA 7398, 8328*. TALEVU: Verata road, *DA 8474*. VANUA LEVU: MBUA without further locality: *DA 5023*. MATHUATA: Tambia, *DA 8767*; banks of lower Lambasa River, *Smith 6632*. THAKAUNDROVE: Savusavu airfield, *DA 8843*. TAVEUNI: Nggathavulo Estate, *DA 8888*.

5. *Digitaria radicata* (Presl) Miq. Fl. Ned. Ind. 3: 437. 1857.

Panicum radicosum Presl, Rel. Haenk. 1: 297. 1830.

Panicum timorense Kunth, R v. Gram. Suppl. IX. 1830?

Digitaria timorensis Balansa in J. Bot. (Morot) 4: 138. 1890; S.T. Blake in Proc. Roy. Soc. Queensland 81: 19. 1969; J.W. Parham, Pl. Fiji Isl. ed. 2. 401. 1972.

Digitaria sanguinalis sensu B.E.V. Parham in Agr. J. Dept. Agr. Fiji 20: 16. 1949, in Proc. 7th Pacific Sci. Congr. 5: 251. 1953; J.W. Parham in Dept. Agr. Fiji Bull. 30: 96. fig. 40, p. p. 1956, in op. cit. 35: 167. 1959, Pl. Fiji Isl. 304. 1964; non Scop.

Culms 15–60 cm. high, branching and rooting at decumbent base; lower portion of leaf sheath pilose; leaf blades 5–15 cm. long, 5–10 mm. broad, pubescent.

TYPEIFICATION AND NOMENCLATURE: *Panicum radicosum* was based on a Haenke specimen collected at Sorzogon, Luzon, Philippine Islands. *Panicum timorense* is a new name for *Digitaria propinqua* Gaud. (non Beauv.), typified by a Gaudichaud specimen from Timor. The oldest epithet for this taxon would appear to be *radicosum*, published in *Panicum* by Presl in 1830. I have been unable to ascertain a correct date for Kunth's publication of *Panicum timorense*, but it would seem certainly to have been later than 1830. In view of this, it is strange that Blake in 1969 accepted *Digitaria timorensis* as the correct name for the taxon. In much of the grass literature this species has been referred to as *D. sanguinalis*, but Linnaeus's *Panicum sanguinale* (Sp. Pl. 57. 1753) is now considered to represent a different species.

DISTRIBUTION: Mauritius, India, Ceylon, and China to New Guinea and Australia, and eastward to Tahiti and Hawaii. In Fiji it is a moderately common grass, represented by at least 25 collections, occurring from sea level to about 80 m. on cultivated land, along roadsides, and on riverbanks and hillsides. Flowers occur throughout the year.

LOCAL NAME AND USE: *Large crab grass*; the species is reputed to be a good fodder grass, but in Fiji it is more often considered a serious weed of cultivation.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Nandarivatu, DA 8505. RA: District Farm, Ndombuilevu, DA 7842. NAITASIRE: Adi Cakobau School Farm, Sawani, DA 7958; Plant Introduction and Quarantine Station, Nanduruloulou, DA 7386, p. p. TAILEVU: Ratu Kadavulevu School Farm, Londoni, DA 8463. REWA: Suva wharf, DA 9124. OVALAU: Wainaloka, DA 1345. VANUA LEVU: THAKAUNDROVE: Namawa Estate, DA 8836; Valethi, Savusavu, DA 8865; Vunalandi, DA 8957. TAVEUNI: Waiyevo, near Rest House, DA 8938; Ngathavulo Estate, DA 8885; Vuna, DA 5735.

6. *Digitaria milaniana* (Rendle) Stapf in Prain, Fl. Trop. Afr. 9: 453. 1919; J.W. Parham, Pl. Fiji Isl. 304. 1964, ed. 2. 401. 1972.

Panicum milanianum Rendle in Trans. Linn. Soc. Bot. 4: 56. 1894.

Digitaria melangiana "Buese" sensu B.E.V. Parham in Agr. J. Dept. Agr. Fiji 20: 16. 1949, in Proc. 7th Pacific Sci. Congr. 5: 238. fig. 5. 1953; J.W. Parham in Dept. Agr. Fiji Bull. 30: 95. pl. VI. 1956.

Culms erect, 90–120 cm. high, the nodes prominent, pubescent; leaves tufted at base in young stages of growth, pubescent, the blades 10–20 cm. long, 6–12 mm. broad; racemes 6–12, erect to ascending, given off from apex of culm.

TYPEIFICATION: Rendle's original material came from Mt. Milanje, Nyasaland, Africa, collected by Whyte.

DISTRIBUTION: A native of tropical Africa now grown in other tropical countries as a pasture grass. It was introduced into Fiji in 1945 for trial and has become naturalized in some places. Flowers are usually noted in February. It is not frequent, and all specimens at hand are listed below.

LOCAL NAME AND USE: *Woolly finger grass*. *Digitaria milaniana* is considered to be an excellent pasture grass, but it appears unable to compete with other naturalized grasses under grazing conditions in Fiji.

AVAILABLE COLLECTIONS: VITI LEVU: RA: On roadside near C.S.R. beef cattle estate, *DA 9063*. NAITASIRI: Research Station, Koronivia, *DA 4006, 7629, 8975*; Plant Introduction and Quarantine Station, Nanduruloulou, *DA 7028*.

7. *Digitaria decumbens* Stent in *Bothalia* 3 (1): 150. 1930; J. W. Parham, Pl. Fiji Isl. 303. 1964, ed. 2. 400. 1972.

Perennial, the culms rooting at nodes, 37–45 cm. high; leaf blades and sheaths glabrous, the ligule ciliate, the blades 10–20 cm. long, 2–5 mm. broad; racemes digitate, 5–7.

TIPIFICATION: The holotype, deposited at Pretoria, is *Pentz 8495*, from Nelspruit, Barberton District, Transvaal, Africa.

DISTRIBUTION: A native of Africa which has been tried as a pasture grass in many parts of the tropical world. It was introduced into Fiji in 1957 and planted out in several places, but it is reported to be suffering from a virus disease, "Pangola stunt virus". It probably is not surviving as a naturalized grass. Flowers have been noted in January, May, and June.

LOCAL NAME AND USE: *Pangola grass*. Although initially showing great promise as a pasture grass, *Digitaria decumbens* is not now being recommended because of the virus disease.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Mba Closed Area plot, *DA 12315*. VANUA LEVU: MATHUATA: District Farm Northern, Seanggangga, *DA 15295*.

8. *Digitaria ciliaris* (Retz.) Koeler, Descr. Gram. Gallia et Germania, 27. 1802; S. T. Blake in Proc. Roy. Soc. Queensland 81: 10. 1969; J. W. Parham, Pl. Fiji Isl. ed. 2. 400. 1972.

Panicum ciliare Retz. Obs. Bot. 4: 16. 1786.

Panicum adscendens H. B. K. Nova Gen. et Sp. 1: 97. 1816.

Digitaria fimbriata Link, Hort. Reg. Bot. Berol. 1: 226. 1827.

Paspalum filiforme sensu Rendle in J. Linn. Soc. Bot. 39: 181. 1909; non L.

Digitaria marginata var. *fimbriata* Stapf in Prain, Fl. Trop. Afr. 9: 440. 1919; Summerhayes & Hubbard in Kew Bull. 1930: 256. 1930.

Digitaria chinensis sensu Summerhayes & Hubbard in Kew Bull. 1927: 32. 1927, in op. cit. 1930: 256. 1930; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 20: 16. 1949; J. W. Parham in Dept. Agr. Fiji Bull. 30: 98. 1956; non Hornem.

Digitaria adscendens Henrard in Blumea 1: 92. 1934; J. W. Parham, Pl. Fiji Isl. 303. 1964.

Digitaria sanguinalis sensu J. W. Parham in Dept. Agr. Fiji Bull. 30: 96. fig. 40, p. 1956; non Scop.

Culms 60–120 cm. high; lower portion of sheath sparsely pilose; leaf blades usually more or less glabrous but sometimes pubescent, 7.5–15 cm. long, 5–10 mm. broad; racemes 4–9, ascending, digitate with 1 or 2 whorls given off below.

TIPIFICATION AND NOMENCLATURE: Blake in 1969 clarified the confused nomenclature of this species, which has many more synonyms than those listed above found in the literature referring to Fiji. As lectotype of *Panicum ciliare*, Blake indicates a Canton specimen (without collector's name) found in the Retzius herbarium at LD (Lund). *Panicum adscendens* is based on several *Humboldt & Bonpland* specimens from Venezuela, Ecuador, Peru, and Mexico. *Digitaria fimbriata* was first described from a plant of Brazilian origin grown at Berlin. Blake has recognized various subspecies of *D. ciliaris*, ours according to Blake belonging to subsp. *ciliaris*.

DISTRIBUTION: *Digitaria ciliaris* is now widespread throughout the tropics. In Fiji it is common in cultivated areas, waste places, along roadsides, and on open hill-sides, occurring from sea level to about 1,000 m. It is to be found in flower throughout the year. At least 80 Fijian collections, and probably more, are in the world's herbaria.

LOCAL NAME AND USE: *Large crab grass*. The species is essentially without economic value; it has become a troublesome weed of cultivation.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Ndrasa, near Lautoka, *DA 10336*; Natawa, Tavua, *DA 8160*; Nandarivatu, *Gibbs 867*; Mt. Nanggaranambuluta, near Nandarivatu, *DA 2429*. NANDRONGA & NAVOSA: Lombau Farm, *DA 7995*. NAMOSI: Wainilotulevu, *DA 9104*. RA: Rewasa, *DA 8077*; Vaileka, *DA 7046*. NAITASIRI: Vinindawa, *DA 8379*; Nasinu Training College Farm, *DA 9386*; Koronivia, *DA 7547*. TAILEVU: Navuloa, in plantation, *DA 9322*. REWA: Ndelainivesi, Suva, *DA 9095*. VANUA LEVU: MATHUATA: Nakamba, on riverbank, *DA 8733*; Yaro Village, Kia Island, *DA 11774*; Tambia, *DA 8746*; Semaniura, Lambasa, *DA 10474*; Nakoroutari, *DA 11768*. TAVEUNI: Waiyevo, *DA 8942*.

9. *Digitaria setigera* Roth ex Roemer & Schultes, Syst. Veg. 2: 474. 1817.

Panicum pruriens Fischer ex Trin. Gram. Panic. 77. 1826.

Digitaria pruriens Buse in Miq. Pl. Junghuhn. 379. 1854; Summerhayes & Hubbard in Kew Bull. 1927: 31. 1927, in op. cit. 1930: 255. 1930; Greenwood in J. Arnold Arb. 25: 404. 1944; B.E.V. Parham in Agr. J. Dept. Agr. Fiji 20: 16. 1949; J.W. Parham in Dept. Agr. Fiji Bull. 30: 96. 1956. Pl. Fiji Isl. 304. 1964, ed. 2. 401. 1972; S.T. Blake in Proc. Roy. Soc. Queensland 81: 18. 1969.

Digitaria sanguinalis sensu Seem. in Bonplandia 9: 261. 1861, Viti, 444. 1862; non Scop.

Panicum sanguinale sensu Seem. Fl. Vit. 325. 1873; non L.

Perennial, the culms erect or ascending from a creeping base, 15–60 cm. high; leaf sheaths usually hairy, the blades usually glabrous but sometimes sparsely pubescent, narrowly lanceolate, 8–20 cm. long, 5–12 mm. broad, the margins thickened; racemes usually 6–12.

TYPIFICATION AND NOMENCLATURE: *Digitaria setigera* is based on material obtained by Benjamin Heyne in India. *Panicum pruriens* is lectotypified (according to Blake) by a specimen collected by Langsdorff (LE) in the Marquesas Islands. Blake in 1969 greatly clarified the complex synonymy of this species, although he did not note the prior epithet *setigera*.

DISTRIBUTION: India to Malesia, eastward to Queensland and in the Pacific to Hawaii. It was first noted in Fiji by Seemann in 1860 on the basis of material obtained by himself and Home. In Fiji it now occurs from sea level to about 350 m. in wet, open places, on edges of forests, on gravel banks of streams, and also as a weed in villages and along roadsides. Approximately 30 Fijian collections are at hand. Flowers have been noted between April and November. The species is considered a weed of cultivation.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Lautoka, *Greenwood* in April, 1919; vicinity of Nalotawa, eastern base of Mt. Evans Range, *Smith 4261*. NANDRONGA & NAVOSA: Singatoka Valley road, *DA 9137*; Yanutha, near coast, *DA 9031*. NAMOSI: Valley of Wainambua Creek, south of Mt. Naitarandamu, *Smith 8844*. RA: District Farm, Ndombulevu, *DA 7810*; Naingani Island, *DA 3352*. NAITASIRI: Near Nawanggambena, *DA 1216*; between Suva and Nasinu, Gillespie 3163.2. TAILEVU: East of Wainimbuka River, Ndakuivuna Village, *Smith 7083*; Wailotua cave, *DA 9420*. REWA: Lokia, *DA 8594*. MBE-NGGA: *DA 9081*. KANDAVU: Ngaloa Island, *DA 9068*. OVALAU: Wainaloka, *DA 1361*. NGAU: Hills east of Herald Bay, inland from Sawaeke, *Smith 7969*. VANUA LEVU: THAKAUNDROVE: Vunimoli, Savusavu, *DA 8857*. TAVEUNI: Vindala, *DA 8872*. THITHIA: Rasea, *DA 13249*. FIJI without further locality, *Home, Seemann 690*.

24. *ERIOCHLOA* H.B.K. Nova Gen. et Sp. 1: 94. 1816.

Annuals or perennials; panicle terminal, of several to many racemes, these spreading or appressed, generally approximate along a common axis; spikelets pubescent, solitary, occasionally in pairs, short-stalked or sessile, in 2 rows on one side of a narrow rachis, the lower rachilla joint thickened, forming a dark-colored, ringlike callus below upper glume; fertile lemma indurate, mucronate or awned, the margins slightly inrolled.

LECTOTYPE SPECIES: *Eriochloa distachya* H.B.K. (ING).

DISTRIBUTION: About 20 tropical and subtropical species. One species is known to occur in Fiji and was, presumably, an accidental introduction. A second species,

Eriochloa polystachya H. B. K. (cf. J. W. Parham in Dept. Agr. Fiji Bull. 30: 93. 1956), the *carib grass* or *malojilla*, was introduced into Fiji for trial in 1920, but it has since disappeared from cultivation and probably no longer occurs in Fiji.

1. *Eriochloa procera* (Retz.) Hubbard in Kew Bull. 1930: 256. 1930; Greenwood in J. Arnold Arb. 25: 404. 1944, in op. cit. 36: 400. 1955; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 20: 17. 1949; J. W. Parham in Dept. Agr. Fiji Bull. 30: 93. 1956, Pl. Fiji Isl. 305. 1964, ed. 2. 403. 1972.

Agrostis procera Retz. Obs. Bot. 4: 19. 1786 (or 1787).

Milium ramosum Retz. Obs. Bot. 4: 22. 1786 (or 1787).

Eriochloa ramosa Kuntze, Rev. Gen. Pl. 2: 775. 1891; Summerhayes & Hubbard in Kew Bull. 1927: 32. 1927; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 20: 17. 1949.

Annual, tufted grass, the culms spreading at base, 22–90 cm. high; leaf blades flat, 2.5–10 cm. long, 3–5 mm. broad; axis and rachis villous, the pedicels with several long hairs; spikelets about 3 mm. long, appressed-pubescent except near tip, a marked calluslike ring below each spikelet.

TYPIFICATION AND NOMENCLATURE: Both taxa concerned in the synonymy were based on plants from India. It would seem to me that Kuntze's combination in *Eriochloa* has priority over Hubbard's, since the basionyms date from the same publication, but without further study I here accept Hubbard's decision.

DISTRIBUTION: Southeastern Asia, Burma, India, Ceylon, and tropical Africa. In Fiji, in spite of the fact that there are not many collections, it is a fairly common weed of gardens, roadsides, hillsides, pathways, and lawns, occurring from sea level to about 100 m. It has been observed to flower in most months of the year.

AVAILABLE COLLECTIONS: VITI LEVU: NAITASIRE: Mbatiki, Nanduruloulou, DA 5603; between Suva and Nasinu, Gillespie 3163.8; Nasinu Training College Farm, DA 8034, 9054, 9383. TAILEVU: Wainivesi road, DA 7725. REWA: Rodwell road, Suva, DA 8582; Sukuna road, Suva, DA 9056; Stinson Parade, Suva, DA 17344; Ndelainivesi, DA 9090. KANDAVU: DA 8677. VANUA LEVU: THAKAUNDROVE: Savu-savu airport, DA 14306.

25. *BRACHIARIA* Griseb. in Ledeb. Fl. Ross. 4: 469. 1853.

Annuals or perennials, branching and spreading; leaf blades linear; racemes several to many, spreading or appressed, approximate along a common axis; spikelets solitary, only rarely in pairs, sessile and in 2 rows along one side of a flat or 3-angled (triquetrous), often narrowly winged, rachis; lower glume turned toward the rachis, the upper glume and sterile lemma approximately equal, usually 5–7-nerved, the lemma enclosing a hyaline palea and occasionally a ♂ flower; fertile lemma indurate, usually papillose-rugose, the margins inrolled, the apex very occasionally mucronate or bearing a short awn.

TYPE SPECIES: *Brachiaria caucasica* (Trin.) Griseb. (*Panicum causicum* Trin.) (ING).

DISTRIBUTION: *Brachiaria* is believed to comprise approximately 50 species distributed throughout the warmer regions of the world. Nine species have been reported from Fiji, but only seven of these are naturalized or established as pasture grasses. The other two, *B. decumbens* Stapf (represented by DA 13190, Mba Closed Area plots, Viti Levu, and DA L.13387, probably from Thakaundrove Province, Vanua Levu) and *B. ruziziensis* Germain & Everard (represented by DA 13189, Mba Closed Area plots) have shown some promise in pasture trials conducted by the Department of Agriculture, but they are not yet known to occur outside of trial plots.

USEFUL TREATMENT OF GENUS: Blake, S. T. *Brachiaria* (in Taxonomic and nomenclatural studies in the Gramineae, No. 2) in Proc. Roy. Soc. Queensland 81: 3–7. 1969.

KEY TO SPECIES

Rachis more or less flat, sometimes ribbonlike.

Racemes 9–20, the spikelets solitary, 2.5–3 mm. long, purple-tinged, densely and irregularly crowded in more than 2 rows on rachis, the lower branches often branched, the base bearing numerous silky hairs. 1. *B. mutica*

Racemes 2–4, the spikelets glabrous, borne in 1 row, 3–4 mm. long, the lower glume as long as spikelet. 2. *B. humidicola*

Rachis triquetrous, sometimes filiform.

Lower glume two-thirds to three-quarters length of spikelet. 3. *B. paspaloides*

Lower glume not more than half length of spikelet.

Panicle linear, with appressed racemes of closely crowded softly hairy spikelets, 2–2.5 mm. long, the rachis hairy, the lower glume a minute scale, the spikelets sometimes purple-tipped. 4. *B. eruciiformis*

Panicle oblong, lanceolate or spreading, the lower glume up to half as long as spikelet.

Spikelets paired, 1.25–2 mm. long, the pedicels with long white bristles, the lower glume truncate. 5. *B. reptans*

Spikelets subsessile, 4–6 mm. long, borne on underside of purple-tinged rachis, the pedicels solitary, very short, stout. 6. *B. brizantha*

Spikelets 3.5–4 mm. long, elliptic-oblong, gradually tapering to base and apex, almost acuminate, the lower glume less than one-quarter length of spikelet; peduncle below inflorescence glabrous. 7. *B. subquadrifera*

1. *Brachiaria mutica* (Forssk.) Stapf in Prain, Fl. Trop. Afr. 9: 526. 1919; Summerhayes & Hubbard in Kew Bull. 1927: 33. 1927, in op. cit. 1930: 256. 1930; B. E. V. Parham, Fijian Pl. Names, 54. 1942, in Agr. J. Dept. Agr. Fiji 20: 15. 1949, in Proc. 7th Pacific Sci. Congr. 5: 222–248. 1953; Greenwood in Proc. Linn. Soc. 154: 106. 1943; J. W. Parham in Dept. Agr. Fiji Bull. 30: 87. fig. 35. 1956, in op. cit. 35: 164. fig. 90. 1959, Pl. Fiji Isl. 310. 1964, ed. 2. 397. 1972; Blake in Proc. Roy. Soc. Queensland 81: 5. 1969.

Panicum muticum Forssk. Fl. Aegypt.-Arab. 20. 1775.

Culms decumbent, rooting at base, 60–240 cm. high, stoloniferous, the nodes densely villous; sheaths villous or glabrous on upper portion with densely pubescent collar; leaf blades 10–30 cm. long, 5–15 mm. broad, flat, glabrous; panicle 15–30 cm. long, the racemes 9–20, densely flowered in irregularly arranged rows, somewhat distant, ascending to spreading, 2.5–10 cm. long; spikelets subsessile, often purple-tinged; fruit minutely transversely rugose.

TIPIFICATION: The holotype is *Forsskal* (C) from Rosetta, Egypt.

DISTRIBUTION: A native of northern Africa, this grass was probably established in tropical America in the early days of trading. It is now found in many warm countries as a pasture grass. The species was introduced into Fiji in 1877 by Scott and Harvey, and it is now widespread from sea level to about 800 m., especially in the wet zones, where it occurs in pastures and cultivated fields, along roadsides, on river banks, in swamps, in clearings, and along forest trails. I have examined about 40 collections. Flowers seem to occur between March and November.

LOCAL NAMES AND USES: *Para grass*; *Mauritius grass*. *Brachiaria mutica* is an excellent pasture and fodder grass, which requires good management to be used intensively. However, it is also a serious weed of sugarcane fields and cultivation.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Forestry Nursery, Lautoka, DA 8212; near Nandi airport, DA 8251. NANDRONGA & NAVOSA: Agricultural Station, Nathotholevu, Singatoka, DA 8572. SERUA: Tokotoko road, Navua, DA 8663. RA: Rewasa, Vaileka, DA 8094. NAITASIRI: Viria, Meebold 17097; Nauluwai, Vinindawa, DA 8428; vicinity of Nasinu, Gillespie 3461; Kalambo, Bryan 216; Koronggangga, DA 3502. TAILEVU: Vungalei, DA 3517. REWA: Nakaile, DA 8620. VANUA LEVU: MATHUATA: Tambia, DA 8751. Summerhayes and Hubbard have also reported a Tothill collection from the island of Mbatiki.

2. *Brachiaria humidicola* (Rendle) Schweickerdt in Kew Bull. 1936: 297. 1936; J. W. Parham, Pl. Fiji Isl. ed. 2. 397. 1972.

Panicum humidicolum Rendle, Cat. African Pl. Welw. 2: 169. 1899, in J. Linn. Soc. Bot. 40: 229. 1911.
Brachiaria dictyoneura Stapf in Prain, Fl. Trop. Afr. 9: 512, p. p. 1919.

Perennial, creeping, giving rise to a number of stolons with culms arising at intervals, these usually geniculately ascending, often rooting at nodes, 45–90 cm. high; leaf blades 6–15 cm. long, 5–8 mm. broad, glabrous; racemes 2–4, rarely more, 3.5–5 cm. long, the rachis more or less flat; spikelets 3–4 mm. long, elliptic to broadly elliptic; lemma of upper floret with an inconspicuous apiculus, usually pure white when mature.

TIPIFICATION AND NOMENCLATURE: The type locality is Africa for both names concerned; the holotype of *Panicum humidicolum* is Welwitsch 2678 (BM), collected near the Monino River, Huilla, Angola. Apparently Stapf's taxon was a mixture, and the plant in Fiji is actually *Brachiaria humidicola*.

DISTRIBUTION: An African grass which was introduced into Fiji for trial as a pasture grass in 1958. It is now established in several dairying and beef cattle areas, especially in the wet and intermediate zones, in spite of the paucity of collections. The original introduction number was FDA 15074, but records fail to show which introduction plot was concerned. Flowers have been noted only in March and July.

LOCAL NAME AND USE: *Koronivia* grass. It is locally considered to be a very promising pasture grass under good management.

AVAILABLE COLLECTIONS: VANUA LEVU: MATHUATA: District Farm Northern, Seanggangga, DA 15389. VANUA MBALAVU: Near Lomaloma, Garnock-Jones 1083.

3. *Brachiaria paspaloides* (Presl) Hubbard in Hook. Icon. Pl. 34: sub t. 3363. 1938; J. W. Parham in Dept. Agr. Fiji Bull. 30: 89. 1956, Pl. Fiji Isl. 301. 1964, ed. 2. 397. 1972.

Urochloa paspaloides Presl, Rel. Haenk. 1: 318. 1830; Summerhayes & Hubbard in Kew Bull. 1927: 36. 1927, in op. cit. 1930: 258. 1930.

Panicum ambiguum Trin. in Mém. Acad. Imp. St.-Pétersb. VI. Sci. Math., Seconde Pt. Sci. Nat. 3: 243. 1835; Seem. Fl. Vit. 325. 1873; J. W. Parham in Dept. Agr. Fiji Bull. 30: 57. 1956.

Brachiaria miliiformis sensu J. W. Parham in Dept. Agr. Fiji Bull. 30: 84. fig. 34. 1956, in op. cit. 35: 164. 1959, Pl. Fiji Isl. 301. 1964; non Chase.

Perennial, the culms creeping, slender, branched, 30–150 cm. high, the nodes glabrous; leaf blades glabrous, 5–15 cm. long, 2.5–10 mm. broad; panicle 5–15 cm. long, bearing 2–7 spikelike racemes, these spreading or reflexed; spikelets alike, solitary, falling entire, 2-flowered, the lower glume three-quarters length of spikelet.

TIPIFICATION AND NOMENCLATURE: Presl's species is based on a collection from the Philippine Islands. Trinius was unaware of the earlier name.

DISTRIBUTION: This tropical species was apparently an early introduction into Fiji which has become naturalized and widespread. It is most commonly found at low elevations (usually below 15 m.) along roadsides, in pastures, in waste places, in cultivated areas, near the seashore, and often forming mats on the dry mud of riverbanks. Flowers may be expected in practically any month. Approximately 70 Fijian collections are available in the world's herbaria.

LOCAL NAME AND USES: *Thurston* grass. *Brachiaria paspaloides* is reported to be palatable to cattle but is unable to withstand heavy grazing; it is a good lawn grass in drier areas.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Lautoka, DA 8547; Nandi, DA 9797; shores of Mba River near mouth, Smith 4749. NANDRONGA & NAVOSA: Agricultural Station, Nathotholevu, Singatoka, DA 8978; Lombau Farm, DA 7983. NAMOSI: Wainilotulevu, DA 9103. RA: Near Penang,

DA 7049; Nanokonoko, *DA 7885*. NAITASIRI: Naveisamasama, near Nawanggambena, *DA 1221*; Research Station, Koronivia, *DA 3964*. TAILEVU: Korovou, *DA 1325*. REWA: Suva and vicinity, *Degener & Ordenez 13516*, *DA 1195*. KANDAVU: Ngaloa Island, *DA 9069*. VANUA LEVU: MATHUATA: Lambasa, *Greenwood 593*, *Tothill s. n.* THAKAUNDROVE: Nakama, *DA 5700*. VANUA LEVU without further locality, *U.S. Expl. Exped.*, in 1840. TAVEUNI: Waiyevo, near Rest House, *DA 8940*.

4. *Brachiaria eruciformis* (Sm.) Griseb. in Ledeb. Fl. Ross. **4**: 469. 1853; Greenwood in J. Arnold Arb. **30**: 84. 1949; Swallen in op. cit. **31**: 142. 1950; J. W. Parham in Dept. Agr. Fiji Bull. **30**: 87. *fig. 36*. 1956, in op. cit. **35**: 164. 1959, Pl. Fiji Isl. **300**. 1964, ed. 2. 397. 1972; Blake in Proc. Roy. Soc. Queensland **81**: 4. 1969.

Panicum eruciforme Sm. in Sibthorp, Fl. Graecae Prodr. **44**. *t. 89*. 1806.

Annual, the culms decumbent, spreading, 15–60 cm. high, rooting at lower nodes; leaf blades sparsely pilose, 4–6 cm. long, 2.5–5 mm. broad; flowering culms bearing 6–12 ascending, appressed racemes 5–20 mm. long; spikelets pubescent, 2–2.5 mm. long, the lower glume a minute scale about one-eighth length of spikelet, the upper glume 5-nerved, almost as long as spikelet.

TYPIFICATION: The original material came from Greece. The epithet has often been written as *erucaeformis*, but in the above citations I have not attempted to show which ones are in conflict with ICBN, Rec. 73G.

DISTRIBUTION: Mediterranean Region, Africa, India, America, and now occurring in Queensland and somewhat eastward. It was first reported from Fiji in 1949; it is a low elevation weed (to 60 m.) of sugarcane fields, gardens, roadsides, and damp open places. Flowers have been noted in months scattered throughout the year. It is probably more common than suggested by the few specimens cited below.

USE: *Brachiaria eruciformis* is unpalatable to stock and can be reported only as a minor weed of cultivation.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Lautoka, *Greenwood 1194*, *1212*; Ndrasa, near Lautoka, *DA 10324*; Salovi, near Nandi, *DA 8567*; Namulomulo, near Nandi, *DA 9747*. REWA: Pender Street, Suva, *DA 2619*; Ndelaivivesi, near Suva, *DA 9097*; Langgere, *DA 11181*.

5. *Brachiaria reptans* (L.) Gardn. & Hubbard in Hook. Icon. Pl. **34**: sub *t. 3363*. 1938; J. W. Parham in Dept. Agr. Fiji Bull. **30**: 89. 1956, Pl. Fiji Isl. **301**. 1964, ed. 2. 397. 1972; Blake in Proc. Roy. Soc. Queensland **81**: 6. 1969.

Panicum reptans L. Syst. Nat. ed. 10. 870. 1759; A. C. Sm. in Sargentia **1**: 6. 1942; B. E. V. Parham in Agr. J. Dept. Agr. Fiji **20**: 18. 1949; J. W. Parham in Dept. Agr. Fiji Bull. **30**: 56. 1956.

Urochloa reptans Stapf in Prain, Fl. Trop. Afr. **9**: 601. 1920; Summerhayes & Hubbard in Kew Bull. **1927**: 35. 1927, in op. cit. **1930**: 258. 1930.

Annual and semiprostrate, the culms spreading; leaf blades lanceolate, 1.8–3.7 cm. long, 3–9 mm. broad; flowering culms bearing 3–15 racemes, these spreading to slightly ascending, with long white hairs on axis and pedicels.

TYPIFICATION: Linnaeus originally described this taxon on the basis of West Indian material.

DISTRIBUTION: Known from tropical regions throughout the world. It was apparently first noted in Fiji in 1927 from Lambasa and Lautoka and is now a moderately common weed of sugarcane fields, roadsides, open grasslands, and the seashore, reported from elevations between sea level and about 800 m. It is doubtless more abundant than suggested by the approximately 25 collections known to me. Flowers may be expected throughout the year.

USE: No economic value can be accredited to this species, which is a weed of cultivation and waste places.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Lautoka and vicinity, *Greenwood* 328, 414B, *DA* 8217; Nandi, *DA* 8794; Korovou, east of Tavua, *Degener* 14959; Nandarivatu golf course, *DA* 2352. NANDRONGA & NAVOSA: Agricultural Station, Nathotholevu, Singatoka, *DA* 8568. RA: Ndombulevu, *DA* 7815; Ellington, *DA* 7910. REWA: Suva, *DA* 7171. VANUA LEVU: MATHUATA: Tambia, *DA* 8768. THAKAUNDROVE: Namawa Estate, *DA* 8834. THITHIA: Rasea, *DA* 13250.

6. *Brachiaria brizantha* (Hochst. ex A. Rich.) Stapf in Prain, Fl. Trop. Afr. 9: 531. 1919; J. W. Parham in Dept. Agr. Fiji Bull. 30: 88. 1956, Pl. Fiji Isl. 300. 1964, ed. 2. 396. 1972.

Panicum brizanthum Hochst. ex A. Rich. Tent. Fl. Abyss. 5: 363. 1850.

Culms erect, 60–120 cm. high; leaf blades smooth, markedly nerved, 20–30 cm. long, 6–18 mm. broad; flowering culms bearing up to 4 racemes, these ascending, recurved, the rachis strong and narrow, usually deep purple in color; spikelets large, purple-tinged on margins, 4–6 mm. long, the lower glume purple-tinged, less than half length of spikelet and clasping base of spikelet, the upper glume as long as spikelet, sparsely hairy toward apex.

TYPEFICTION: The original material came from Abyssinia, Africa.

DISTRIBUTION: The species is currently under trial in many parts of the world as a pasture grass; earlier reports that it caused photosensitization in cattle appear to be unfounded. It was introduced into Fiji in 1950 as *FDA 14897* and perhaps under other numbers as trial as a pasture grass, being now established in several localities and showing promise. Flowers have been noted between November and May.

LOCAL NAME AND USE: *Signal grass*. *Brachiaria brizantha* will probably prove to be a useful pasture grass.

AVAILABLE COLLECTIONS: VITI LEVU: NAITASIRI: Koronivia, *DA* 7459, 11778; Nanduruloulou, *DA* 9044. VANUA LEVU: MATHUATA: District Farm Northern, Seangangga, *DA* 15293, 15296. FIJI without further locality, *DA* 12979.

7. *Brachiaria subquadriflora* (Trin.) Hitchcock in Lingnan Sci. J. 7: 214. 1931; *Greenwood* in J. Arnold Arb. 30: 83. 1949; Swallen in op. cit. 31: 141. 1950; J. W. Parham in Dept. Agr. Fiji Bull. 30: 84. 1956, Pl. Fiji Isl. 301. 1964, ed. 2. 397. 1972.

Panicum subquadriflorum Trin. Gram. Panic. 145. 1826.

Brachiaria distachya sensu Summerhayes & Hubbard in Kew Bull. 1927: 32. 1927, in op. cit. 1930: 256. 1930; *Greenwood* in J. Arnold Arb. 25: 404. 1944; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 20: 15. 1949, in Proc. 7th Pacific Sci. Congr. 5: 229, 233. 1953; non Stapf.

Culms 30–60 cm. high, rising from creeping, stoloniferous runners, the nodes glabrous; leaf blades glabrous, 5–15 cm. long, 2.5–10 mm. broad; flowering culm bearing 3–5 (sometimes 2–10) racemes, these spreading to descending, 1.8–5 cm. long; spikelets alike, about 3.5 mm. long, glabrous, the lower glume less than one-quarter length of spikelet, clasping base of spikelet, 5–7-nerved, the margins overlapping, the upper glume as long as spikelet, 7-nerved, fertile, the lemma transversely rugose.

TYPEFICTION AND NOMENCLATURE: The original material was from the Marianna Islands. Swallen in 1950 pointed out that previous identifications of this species as the Indian *Brachiaria distachya* were in error, although he considered the two taxa very close.

DISTRIBUTION: Now widespread in the tropics; first recorded from Fiji in 1927 and now frequent from sea level to about 800 m., occurring in pastures and cane-fields, along roadsides, and on seashores. Flowers are to be seen throughout the year. About 60 Fijian collections are available in the world's herbaria.

USE: The species seems to have no local name in Fiji, and it is probably worthless as a pasture grass.

REPRESENTATIVE COLLECTIONS: YASAWAS: WAYA: Along Wailevu Creek, *St. John* 18088. VITI LEVU: MBA: Lautoka, *DA* 10345; Nandi-Lautoka road, *DA* 8256; near Lautoka golf course, *DA* 8224; Tavua, *DA* 8182; Vatia Point, *DA* 2814; Maleli, Nandarivatu road, *DA* 8157. NANDRONGA & NAVOSA: Agricultural Station, Nathotholevu, Singatoka, *DA* 7236; Lombau Farm, *DA* 7981. SERUA: Yanutha Island, *DA* 9026; Naitonitoni, *DA* 8652. RA: Rewasa, *DA* 8076; near Penang, *DA* 7042; District Farm, Ndombuilevu, *DA* 7861; Ellington, *DA* 7905; Naingani Island, *DA* 3375. NAITASIRE: Research Station, Koronivia, *DA* 11791; Queen Victoria School Farm, Matavatathou, *DA* 7778. REWA: Suva, *DA* 2894. OVALAU: Vicinity of Thawathi, *Smith* 8097. VANUA LEVU: MATHUATA: Nakamba, *DA* 8736. THAKAUNDROVE: Vunalangi, *DA* 8950. TAVEUNI: Vuna, *DA* 5736. Summerhayes and Hubbard have also recorded this species from Tothill collections made on the islands of Moturiki, Koro, Mbatiki, Matuku, Kanathea, Vanua Mbalavu, Mango, and Fulanga.

26. *AXONOPUS* Beauv. Ess. Nouv. Agrost. 154. 1812.

Perennials or annuals, stoloniferous or tufted; leaf blades usually flat or folded, abruptly rounded or somewhat pointed; racemes spike-like, slender, digitate or racemose along main axis; spikelets oblong, solitary, sessile, alternate in 2 rows on one side of a triquetrous rachis.

LECTOTYPE SPECIES: *Axonopus compressus* (Sw.) Beauv. (*Milium compressum* Sw.) (ING).

DISTRIBUTION: Tropical America, with about 35 species. Several species are widespread and two have been introduced into Fiji and are now naturalized and common.

KEY TO SPECIES

- Nodes densely hairy; leaf blades broad, flat, moderately hairy on margins; flowering culms short, usually mostly surrounded by leaf sheath. 1. *A. compressus*
 Nodes glabrous or sparsely hairy; leaf blades narrow, keeled, glabrous or with a few scattered hairs; flowering culms 30–90 cm. long, slender, protruding well beyond end of sheath. 2. *A. affinis*

1. *Axonopus compressus* (Sw.) Beauv. Ess. Nouv. Agrost. 154. 1812; Summerhayes & Hubbard in Kew Bull. 1927: 33. 1927; B. E. V. Parham, Fijian Pl. Names, 54. 1942, in Agr. J. Dept. Agr. Fiji 20: 15. 1949, in Proc. 7th Pacific Sci. Congr. 5: 222, 230. 1953; Greenwood in J. Arnold Arb. 30: 84. 1949; J. W. Parham in Dept. Fiji Agr. Bull. 30: 90. fig. 37. 1956, Pl. Fiji Isl. 300. 1964, ed. 2. 396. 1972.

Milium compressum Sw. Nov. Gen. & Sp. Prodr. 24. 1788.

Perennial and stoloniferous, the blades of stolons often broader and shorter than those of culm; leaf blades flat, 5–15 cm. long, 2.5–15 mm. broad, the margins ciliate; flowering culms erect, 15–30 cm. long, the racemes usually 3, slender, 3.7–10 cm. long, a pair at summit and 1 below (very occasionally more than 1 below); spikelets about 2.5 mm. long, yellow, ciliate on margins.

TYPIFICATION: Swartz based his species on a plant from Jamaica.

DISTRIBUTION: A native of tropical and subtropical America, which has now become widely distributed as a pasture and lawn grass. It was first recorded from Fiji in 1927 and is now more common than might be suggested by the comparatively few available collections. It occurs between sea level and about 800 m. in pastures and lawns, along roadsides, and on open hillsides, especially in the wet zone. Flowers have been noted in months scattered throughout the year.

LOCAL NAMES AND USES: *Kambutu ni vavalangi*, *carpet grass*, *American carpet grass*, *broad-leaved carpet grass*. It is considered to be a good pasture grass and excellent for lawns in wet areas.

AVAILABLE COLLECTIONS: VITI LEVU: NAITASIRE: Prince's Road, 8 miles from Suva, *DA* 1625; vicinity of Nasinu, *Greenwood* 1108; Wainimbuku, near Nasinu, *DA* 7296, 7297; Research Station, Koronivia, *DA* 3962. TAILEVU: Korovou, *DA* 3631, 3634, 7694; Waimaro, *DA* 7702; Ratu Kadavulevu School Farm, Londoni, *DA* 7770. VANUA LEVU: MATHUATA: Lambasa, *Greenwood* 592; near Ndaku, *DA* 8775.

2. *Axonopus affinis* Chase in J. Wash. Acad. Sci. **28**: 180. 1938; B. E. V. Parham in Agr. J. Dept. Agr. Fiji **20**: 15. 1949, in Proc. 7th Pacific Sci. Congr. **5**: 230. 1953; J. W. Parham in Dept. Agr. Fiji Bull. **30**: 90. fig. 38. 1956, Pl. Fiji Isl. **300**. 1964, ed. 2. 396. 1972.

Perennial and stoloniferous; leaf blades narrow, keeled, glabrous, 7.5–15 cm. long, 2.5–7.5 mm. broad; flowering culms erect, very slender, 30–90 cm. long, the racemes terminal and axillary, usually 3, a pair at summit and 1 below, 3.7–7.5 cm. long; spikelets less than 2.5 mm. long, elongate, sparsely ciliate near margins, greenish yellow in color, sometimes purplish-tinged.

TIPIFICATION: The species is typified by a plant from Waynesboro, Mississippi, U.S.A.

DISTRIBUTION: A native of tropical America, where it is frequently used as a pasture grass. In Fiji it is naturalized from sea level to about 90 m., being common in the wet zones, where it grows in pastures, open fields, coconut plantations, and even on poor hill soils. About 40 collections have been examined, and flowers are noted throughout much of the year.

LOCAL NAME AND USE: *Narrow-leaved carpet grass*. It is a common pasture grass on poor hill soils in the wet zones of Viti Levu.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Government Station, Mba, DA 8195. NANDRONGA & NAVOSA: Agricultural Station, Nathotholevu, Singatoka, DA 8305. NAITASIRI: Government Station, Vunindawa, DA 8448; Adi Cakobau School, Sawani, DA 7625; Nasinu Training College Farm, DA 9397; Research Station, Koronivia, DA 3962; Wainimbuku, near Nasinu, DA 8693; Plant Introduction and Quarantine Station, Nanduruloulou, DA 9042. TAILEVU: Vunindawa turn-off, DA 7952; Korovou, DA 1323; Wainikuvula, DA 7681; Waindialithi, DA 7668; Waimaro, DA 7715; Ratu Kadavulevu School, Londoni, DA 7771. OVALAU: DA 5685. VANUA LEVU: THAKAUNDOVE: Savusavu, C. R. Turbet 15. TAVEUNI: Ngathavulo Estate, DA 8887.

27. *PASPALUM* L. Syst. Nat. ed. 10. 855. 1759; Seem. Fl. Vit. 325. 1873.

Annuals or perennials, the flowering culms bearing 1–many spikelike racemes, these solitary, paired, or several to many on a common axis; spikelets planoconvex, mostly obtuse, subsessile, solitary or in pairs, in 2 rows on one side of a narrow or dilated rachis, the first glume usually absent, the second glume and sterile lemma approximately equal.

LECTOTYPE SPECIES: *Paspalum dimidiatum* L., nom. illeg. (*Panicum dissectum* L.: *Paspalum dissectum* (L.) L.) (ING).

DISTRIBUTION: About 250 species of tropical and warm temperate areas. Many are important pasture grasses. Twelve species have been recorded from Fiji, but of these *Paspalum commersonii*, *P. plicatum*, *P. regnellii*, *P. scrobiculatum*, and *P. simplex* are known only from trial plots. Two of these, *P. plicatum* and *P. simplex*, are showing promise and have, therefore, been included in the key and following treatment. The *P. scrobiculatum* currently under trial should not be confused with the "*P. scrobiculatum*" listed by Seemann, which is referable to *P. orbiculare* as noted below.

Paspalum commersonii Lam. is represented in trial plots by DA 13185 (Mba Closed Area trial plots) and DA 8570, 10841, and 11843 (Agricultural Station, Nathotholevu, Singatoka). *Paspalum regnellii* Mez ex Ekman has been grown in trial plots at Nathotholevu, Singatoka (DA 10842) and at the Plant Introduction and Quarantine Station, Nanduruloulou (DA 7390, 9046). *Paspalum scrobiculatum* L. has been tried at Nathotholevu, Singatoka (FDA 14624, DA 11840), and at

Nanduruloulou (*DA 3058, 10142*). The latter two of these I have noted in Fiji Dept. Agr. Bull. **30**: 80–83. 1956. However, none of the three are likely to become naturalized pasture grasses in Fiji.

KEY TO SPECIES

- Spikelets irregularly arranged in 4 rows on rachis; culms 45–90 cm. high; racemes 20 or more; spikelets brownish. 1. *P. paniculatum*
 Spikelets irregularly arranged in 3 rows on rachis; culms 60–120 cm. high; racemes 5–10, evenly spaced; spikelets olive-green to dark brown in color, glabrous. 2. *P. plicatulum*
 Spikelets arranged in 2 rows on rachis.
 Racemes 1 or 2; culms 15–22 cm. high; spikelets yellow, glabrous; found only in swampy, saline areas. 3. *P. distichum*
 Racemes 2 only.
 Culms 30–90 cm. high; spikelets yellow-green, sparsely pubescent, with silky hairs on margin. 4. *P. conjugatum*
 Culms 45–90 cm. high; spikelets brownish, glabrous. 5. *P. notatum*
 Racemes 2–6; culms 30–90 cm. high.
 Spikelets pale green, pubescent, the margins ciliate. 6. *P. dilatatum*
 Spikelets brown, glabrous; racemes recurved, ascending. 7. *P. orbiculare*
 Racemes 10 or more.
 Culms 60–180 cm. high; racemes 10–24; spikelets olive-green, pubescent. 8. *P. urvillei*
 Culms 45–90 cm. high; racemes 14–22; spikelets purple-tinged, glabrous. 9. *P. simplex*

1. *Paspalum paniculatum* L. Syst. Nat. ed. 10. 855. 1759; Greenwood in J. Arnold Arb. **25**: 404. 1944; J. W. Parham in Dept. Agr. Fiji Bull. **30**: 76. fig. 30. 1956, in op. cit. **35**: 163. fig. 88. 1959, Pl. Fiji Isl. 308. 1964, ed. 2. 408. 1972.

Paspalum galmarra F. M. Bailey in Bot. Bull. Dept. Agr. Brisbane **9**: 12. 1894; Anon. in Dept. Agr. Fiji Circ. **5**: 84. 1924; B. E. V. Parham in Agr. J. Dept. Agr. Fiji **10**: 115. 1939, in op. cit. **20**: 18. 1949, in Proc. 7th Pacific Sci. Congr. **5**: 230. 1953.

Culms erect or decumbent at base, 45–90 cm. high; sheaths papillose-hispid, the leaf blades flat, more or less hispid, 10–25 cm. long, 1–2 cm. broad; panicle 5–10 cm. long, bearing 20 or more spreading, slightly fascicled racemes, these 3.8–10 cm. long; spikelets brownish, about 1.5 mm. long.

TIPIFICATION AND NOMENCLATURE: Linnaeus's description is based upon material from Jamaica, Bailey's from Australia. Greenwood in 1944 pointed out the synonymy.

DISTRIBUTION: Probably a native of the West Indies and South America, *Paspalum paniculatum* has become established in Queensland and elsewhere. It was introduced into Fiji in the early 1920's by R. B. Howard, also becoming established on Tovv Island, Ra Province, Viti Levu. It is now naturalized in Fiji in waste places, pastures, along roadsides, on hillsides, and on plantations and other cultivated areas. It appears to be still restricted to Viti Levu, where it is quite common, approximately 40 collections being available. Flowers are observed throughout the year.

LOCAL NAMES AND USE: *Galmarra grass*; *Russell River grass*. Although the species was introduced as a pasture grass, it is apparently not palatable to cattle and must be considered a weed.

REPRESENTATIVE COLLECTIONS: VITI LEVU: NANDRONGA & NAVOSA: Agricultural Station, Nathotholevu, Singatoka, *DA 8312*. SERUA: Between Ngaloa and Wainiyambia, *Smith 9675*; Navua, *DA 8980*. RA: District Farm, Ndombuilevu, *DA 7319*. NAITASIRE: Tholo-i-suva, *DA 8968*; Wainimbuku, Nasinu, *DA 8694*; Nasinu Training College Farm, *DA 9401*; Koronivia, *DA 7034*. TAILEVU: Londoni, *DA 7760*. Matavatathou, *DA 7775*; Korovou, *DA 1327*; Viwa Farm, *DA 7685*; Waimaro, *DA 7705*; Wainivesi, *DA 7732*. REWA: Suva, C. R. Turbet 13; Department of Agriculture grounds, Suva, *DA 9058*; Lokia, *DA 8593*.

2. ***Paspalum plicatulum*** Michx. Fl. Bor. Amer. 1: 45. 1803; J.W. Parham, Pl. Fiji Isl. ed. 2. 408. 1972.

Culms erect, 60–120 cm. high; leaf blades 15–35 cm. long, 3–7 mm. broad, the margin ciliate near junction with sheath; racemes 5–10, regularly spaced, alternate, ascending, 4–6 cm. long; spikelets irregularly arranged in 3 rows, sparsely pubescent, 2.5–3 mm. long, the lower lemma with short transverse wrinkles inside the raised margin.

TIPIFICATION: The original material came from Georgia, U.S.A.

DISTRIBUTION: The warmer parts of North and South America and the West Indies, where it is an important fodder grass. It was introduced into Fiji in 1957 for trial as a pasture grass and is reported to be showing promise. Flowers have been noted in March and November.

USE: A pasture grass; no local name has yet been recorded.

AVAILABLE COLLECTIONS: VITI LEVU: NANDRONGA & NAVOSA: Agricultural Station, Nathotholevu, Singatoka, *DA 12581*. VANUA LEVU: MATHUATA: District Farm Northern, Seanggangga, *DA 15294, 15391*.

3. ***Paspalum distichum*** L. Syst. Nat. ed. 10. 855. 1759; A. C. Sm. in Bull. Torrey Bot. Club 70: 534. 1943; Greenwood in J. Arnold Arb. 25: 404. 1944; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 20: 18. 1949, in Proc. 7th Pacific Sci. Congr. 5: 237. 1953; J. W. Parham in Dept. Agr. Fiji Bull. 30: 82. 1956, Pl. Fiji Isl. 308. 1964, ed. 2. 407. 1972.

Paspalum vaginatum Sw. Nov. Gen. & Sp. Prodr. 21. 1788; Summerhayes & Hubbard in Kew Bull. 1927: 34. 1927, in op. cit. 1930: 256. 1930; B. E. V. Parham, Fijian Pl. Names, 54. 1942, in Agr. J. Dept. Agr. Fiji 20: 19. 1949, in Proc. 7th Pacific Sci. Congr. 5: 237. 1953; Greenwood in J. Arnold Arb. 25: 404. 1944; J. W. Parham in Dept. Agr. Fiji Bull. 30: 82, fig. 33. 1956, Pl. Fiji Isl. 308. 1964.

Perennial, with stolons creeping widely, glabrous; culms 15–22 cm. high; leaf blades 2.5–15 cm. long, 1.2–5 mm. broad, tapering to an involute apex; racemes 1 or 2, initially erect, at maturity incurved but spreading or reflexed, 2.5–5 cm. long; spikelets solitary, ovate-lanceolate, 3–4 mm. long.

TIPIFICATION AND NOMENCLATURE: Both types concerned probably came from the West Indies.

DISTRIBUTION: Widespread throughout the tropics of the world. In Fiji it is usually found near sea level, more commonly than suggested by the specimens cited below, on beaches and creek banks and in mangrove swamps.

LOCAL NAMES AND USE: *Kambutu*, *swamp couch*, *knot grass*. The species is useful as a sand and soil binder.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Lautoka, *Greenwood 227*; near Nandi, *DA 11706*. SERUA: Waimate Beach, near Ndeumba, *DA 10125*. RA: Rakiraki, *DA 7916*. NAITASIRE: Central Agricultural Station, Navuso, *DA 2346*; Research Station, Koronivia, *DA 3965*. TAILEVU: Matavatathou, *DA 7759*; Tambuninggio, *DA 10061*. REWA: Ndelainivesi, *DA L.11451, L.16688*. KANDAVU: C. R. Turbet 4; Ndaku, *DA 2970*. VANUA LEVU: MBUA: Ndama River near Ndama Village, *DA 16688*. LAKEMBA: Wathiwathi Village, *Garnock-Jones 941*. FIJI without further locality, *DA 3240, 3654*. Summerhayes and Hubbard have also noted that the Tothills collected this species on Tomberua Island (Mbua Province, Vanua Levu), Koro, Mbatiki, Ngau, Moala, Totoya, Matuku, Kanathea, Vanua Mbalavu, and Thikombia-i-Lau.

4. ***Paspalum conjugatum*** Bergius in Acta Helv. Phys.-Math. 7: 129. t. 8. 1772; Thurston, Cat. Trees, Shrubs and Foliage Pl. 18. 1886; Summerhayes & Hubbard in Kew Bull. 1927: 34. 1927, in op. cit. 1930: 256. 1930; Greenwood in J. Arnold Arb. 25: 404. 1944; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 20: 18. 1949, in Proc. 7th Pacific Sci. Congr. 5: 222–248. 1953; J. W. Parham in Dept. Agr. Fiji

Bull. **30**: 73, fig. 28. 1956, in op. cit. **35**: 163, fig. 87. 1959, Pl. Fiji Isl. 308. 1964, ed. 2. 407. 1972.

Extensively creeping, the stolons long and leafy, the nodes markedly pilose; leaf blades usually glabrous, 7.5–15 cm. long, 2.5–7.5 mm. broad; flowering culms 30–90 cm. high, the racemes widely divaricate, usually digitate (although occasionally one slightly below other), 7.5–12.5 cm. long; spikelets ovate, light yellow to green, about 2 mm. long, markedly ciliate on margins.

TYPIFICATION: The original material was collected in Surinam.

DISTRIBUTION: Widespread throughout tropical America, and also in Asia and Africa. It was an early introduction into Fiji, where it is very common at elevations up to 1,300 m., along roadsides and in cultivation, in pastures, villages, plantations, and along beaches and river banks. There are probably at least 100 Fijian collections in the world's herbaria. Flowers may occur in any month.

LOCAL NAMES AND USES: *Sour grass*, "*T*" *grass*, *yellow grass*; sometimes it has incorrectly been called *Thurston grass* (*Brachiaria paspaloides*). Although the species is found on many dairy farms, it is not a good pasture grass and should be considered merely a weed of cultivation and waste places.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Near Lautoka, *DA 8214*; Natawa, Tavua, *DA 8169*; Mt. Nangaranambuluta, east of Nandarivatu, *Smith 4852*; near summit of Mt. Tomanivi, *DA 7103*. NANDRONGA & NAVOSA: Lombau Farm, *DA 7998*; Yanutha Island, *DA 9027*. SERUA: Ngaloa, *Smith 9451*, Tokotoko road, Navua, *DA 8655*. NAMOSI: Mt. Voma, *DA 13978*; near Namuamua, *Smith 9074*. RA: District Farm, Ndombuilevu, *DA 7320*. NAITASIRE: Vunindawa, *DA 8396*; Wainimbuku, Nasinu, *DA 8699*. TAILEVU: Londoni, *DA 7761*; east of Wainimbuka River, near Ndaquivuna, *Smith 7082*. REWA: Mt. Korombamba, *DA 1240*; Suva, C. R. Turbet 46. KANDAVU: Ngaloa, *DA 9070*. OVALAU: Wainiloka, *DA 1359*. VANUA LEVU: MATHUATA: Tambia, *DA 8747*. THAKAUNDROVE: Valethi, *DA 8845*. TAVEUNI: Vicinity of Waiyevo, *Smith 8120*. TOTOYA: *DA 13247*. VANUA MBALAVU: Near Lomaloma, *Garnock-Jones 1142*. LAKEMBA: Near Tumbou Jetty, *Garnock-Jones 779*. Summerhayes and Hubbard also recorded collections made by the Tothills on the islands of Moturiki, Koro, Mbatiki, Nairai, Ngau, Moala, Matuku, Naitamba, Mango, Nayau, and Kambara.

5. *Paspalum notatum* Flügge, Gram. Monogr., *Paspalum*, 106. 1810; B. E. V. Parham in Agr. J. Dept. Agr. Fiji **10**: 115. 1939, in op. cit. **20**: 18. 1949; J. W. Parham in Dept. Agr. Fiji Bull. **30**: 78. 1956, Pl. Fiji Isl. ed. 2. 407. 1972.

Rhizome stout; leaf blades folded or flat, 20–30 cm. long, 5–10 mm. broad; flowering culms 45–90 cm. high, the racemes 2, digitate, usually recurved, ascending, about 10 cm. long; spikelets ovate to obovate, glabrous, brownish-tinged, shiny, 2.5–4 mm. long.

TYPIFICATION: The original material came from St. Thomas, West Indies.

DISTRIBUTION: A native of tropical America, this species has been taken to other tropical areas for trial as a pasture grass. It was first introduced into Fiji in 1938 by R. B. Howard, and a few plants have been noted as escapes. It is currently being grown in trial plots by the Department of Agriculture. Flowers have been recorded between January and August.

LOCAL NAME: *Bahia grass*.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Near Nandi airport, *DA 8248*. NANDRONGA & NAVOSA: Agricultural Station, Nathotholevu, Singatoka, *DA 2351*, *8313*, *8314*, *8571*, *10835*; Yanutha Island, *DA 9032*. SERUA: Navua, *DA 2351*.

6. *Paspalum dilatatum* Poir. in Lam. Encycl. Méth. Bot. **5**: 35. 1804; Summerhayes & Hubbard in Kew Bull. **1927**: 34. 1927, in op. cit. **1930**: 257. 1930; Greenwood in J. Arnold Arb. **25**: 404. 1944; B. E. V. Parham in Agr. J. Dept. Agr. Fiji **20**: 18. 1949, in Proc. 7th Pacific Sci. Congr. **5**: 230–239, fig. 6. 1953; J. W. Parham in

Dept. Agr. Fiji Bull. 30: 75. fig. 29. pl. V. 1956, Pl. Fiji Isl. 308. 1964, ed. 2. 407. 1972.

Culms tufted, leafy at base, ascending or erect from a decumbent base, 30–90 cm. high; leaf blades 10–25 cm. long, 3.7–10 mm. broad; racemes 2–6, usually 3–5, spreading, 6–9 cm. long; spikelets usually arranged in 2 rows (occasionally in 3 rows), pale green, 3–4.5 mm. long, the margins ciliate.

TIPIFICATION: The original material was said to come from Argentina.

DISTRIBUTION: A native of South America, this species is now widespread throughout the world because of its value as a pasture grass. It was an early introduction into Fiji and is now widespread there at elevations up to about 100 m., occurring along roadsides, in pastures, and on hillsides. It is commonly infected by ergot, which gives the spikelets an orange color. I have seen about 40 Fijian collections, but the species is more common than this implies. Flowers have been noted throughout the year.

LOCAL NAME AND USE: *Dallis grass*. Although it is a useful pasture grass, it cannot compete with poorer species under Fijian grazing conditions and therefore is usually found along fence lines in grazed areas.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Lautoka, *Greenwood*, in March 1921. NANDRONGA & NAVOSA: Agricultural Station, Nathotholevu, Singatoka, *DA 11841*. RA: District Farm, Ndombuilevu, *DA 7839*; Matawailevu, *DA 7891*. NAITASIRI: Nasinu, *Gillespie 3606*; Research Station, Koronivia, *DA 3967*; Koronivia, *DA 7965*; Tonga River, near Koronivia, *DA 7507*; Plant Introduction and Quarantine Station, Nanduruloulou, *DA 7387*; Nasinu Training College, *DA 8026*. TAILEVU: Waimaro, *DA 1672*; Korovou, *DA 7690*. REWA: Suva, *DA 7484*. KANDAVU: Vunisea, *DA 9059*; hill above Ndingegele, *DA 2989*. VANUA LEVU: MATHUATA: Tambathola, *DA 8730*. TAVEUNI: Vatuwiri, *DA 8918*. RAMBI: *DA 5743*.

7. *Paspalum orbiculare* Forst. f. Fl. Ins. Austr. Prodr. 7. 1786; Summerhayes & Hubbard in Kew Bull. 1927: 34. 1927, in op. cit. 1930: 257. 1930; B.E.V. Parham, Fijian Pl. Names, 54. 1942, in Agr. J. Dept. Agr. Fiji 20: 18. 1949, in Proc. 7th Pacific Sci. Congr. 5: 230, 236. fig. 13. 1953; J.W. Parham in Dept. Agr. Fiji Bull. 30: 78. fig. 31. 1956, in op. cit. 35: 164. fig. 89. 1959, Pl. Fiji Isl. 308. 1964, ed. 2. 407. 1972.

Paspalum cartilagineum Presl, Rel. Haenk. 1: 216. 1830.

Paspalum scrobiculatum sensu Seem. in Bonplandia 9: 261. 1861, Viti, 444. 1862, Fl. Vit. 326. 1873; C. H. Wright in Dept. Agr. Fiji Bull. 10: 3. 1918, in Dept. Agr. Fiji Circ. 3: 40. 1922; H.B.R. Parham, Names Fijian Pl. Bot. Equiv. 3. 1935, in Polynesian Soc. Mem. 16: 14. 1943; B.E.V. Parham in Agr. J. Dept. Agr. Fiji 20: 18. 1949, in Proc. 7th Pacific Sci. Congr. 5: 239. 1953; J.W. Parham in Dept. Agr. Fiji Bull. 30: 80. 1956, Pl. Fiji Isl. 308. 1964; non L.

Paspalum orbiculare var. *cartilagineum* Summerhayes & Hubbard in Kew Bull. 1930: 257. 1930; J.W. Parham, Pl. Fiji Isl. 308. 1964, ed. 2. 408. 1972.

Perennial, the culms erect, 30–90 cm. high; leaf blades narrow, 10–25 cm. long, 2.5–10 mm. broad; racemes 2–6, usually 4 or 5, spreading, ascending, 3–5 cm. long; spikelets broadly elliptic, brownish-colored, glabrous, about 2.5 mm. long, the lower lemma membranous or cartilagineous.

TIPIFICATION: The type material of *Paspalum orbiculare* was collected in the Society Islands, presumably by the Forsters. The other taxon which is now referred to this species may also have come from that area. Intraspecific categories in *P. orbiculare* require further study.

DISTRIBUTION: A native of tropical Asia, this grass is now widespread throughout the Pacific. It was first recorded from Fiji by Seemann (as *Paspalum scrobiculatum*)

and is now abundant at elevations up to 1,300 m. in clearings, along roadsides, in pastures, ditches, waste land, etc. More than 80 collections are available. Flowers are to be expected throughout the year.

LOCAL NAMES AND USE: *Tho nduru levu, tho ndina, tho ni ndina, ditch millet, native Paspalum*. The species is not palatable to cattle and must be considered a weed.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Lautoka, *DA 8231*; Sambeto Valley, *DA 8264*; vicinity of Nalotawa, eastern base of Mt. Evans Range, *Smith 4260*. NANDRONGA & NAVOSA: Lombau Farm, *DA 7990*. SERUA: Ndeumba, *DA 8626*. NAMOSI: Valley of Wainambua Creek, south of Mt. Naitarandamu, *Smith 8831*. RA: District Farm, Ndombulevu, *DA 7324*; near Vaileka, *DA 8134*. NAITASIRI: Nasinu, *DA 7508*; Nanduna, *DA 9606*. TAILEVU: Near Londoni, *DA 7767*; Wainivesi road, *DA 7723*. REWA: Mt. Korombamba, *DA 1173*. KANDAVU: Ngaloa Island, *DA 9074*. OVALAU: Wainiloka, *DA 1349*. NGAU: MacGillivray & Milne; inland from Sawaieke, *Smith 7970*. VANUA LEVU: MATHUATA: Vicinity of Natua, *Smith 6881*; Tambia, *DA 8765*. THAKAUNDROVE: Savusavu, *DA 8867*. TAVEUNI: Waitavala, *DA 8892*. RAMBI: *DA 3083*. VANUA MBALAVU: Near Lomaloma, *Garnock-Jones 1091*. LAKEMBA: Ridge east of Levuka Valley, *Garnock-Jones 834*. FIJI without further locality, *Seemann 682*.

8. *Paspalum urvillei* Steudel, Syn. Pl. Glum. 1: 24. 1853; Summerhayes & Hubbard in Kew Bull. 1930: 257. 1930; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 20: 19. 1949; J. W. Parham in Dept. Agr. Fiji Bull. 30: 81. fig. 32. 1956, Pl. Fiji Isl. 308. 1964, ed. 2. 408. 1972.

Culms erect, in large clumps, 60–180 cm. high; lower part of sheath hirsute, the leaf blades pilose at base, 20–60 cm. long, 2.5–20 mm. broad; panicle erect, with 10–24 racemes, these crowded, ascending to erect, 5–15 cm. long; spikelets ovate, about 2.5 mm. long, olive-green in color, pubescent, fringed with long, silky, white hairs.

TYPIFICATION: The original material is believed to have come from Brazil.

DISTRIBUTION: A native of Uruguay and Argentina, now occurring in many other countries. In Fiji the species was first noted at Nandarivatu by Tothill, and it has become established at a number of other places at elevations up to 900 m. Apparently it spreads slowly along roadsides and on river flats. Flowers have been recorded in months scattered throughout the year.

LOCAL NAME: *Vasey grass*. In Fiji *Paspalum urvillei* is considered to be of no economic value.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Nandarivatu, *Gillespie 4276, DA 2095, 3630, 6067, 9726, 17328*. NAITASIRI: Research Station, Koronivia, *DA 3968, 7447*; Mbatiki, Nanduruloulou, *DA 7523*. TAILEVU: Korovou, *DA 5628, 7674, 9114*; Waimaro, *DA 7706*.

9. *Paspalum simplex* Morong in Ann. New York Acad. Sci. 7: 259. 1893; J. W. Parham, Pl. Fiji Isl. ed. 2. 408. 1972.

Culms erect, 45–90 cm. high; leaf blades tapering to a fine point, 10–25 cm. long, 6–10 mm. broad, the margins finely dentate-ciliate; racemes 14–22, ascending, fairly crowded, 25–40 mm. long; spikelets glabrous, purple-tinged, borne in 2 ranks, about 2 mm. long.

TYPIFICATION: The original material came from Paraguay.

DISTRIBUTION: A South American grass, *Paspalum simplex* was introduced into Fiji in 1954 for trial as a pasture grass. It is reported to be showing promise and to have been seen as an escape outside the trial areas; it will probably become naturalized. Flowers have been noted in May and November.

USE: A promising pasture grass, although not yet established in Fiji.

AVAILABLE COLLECTIONS: VITI LEVU: NANDRONGA & NAVOSA: Agricultural Station, Nathotholevu, Singatoka, *DA 9781, 9782, 10834*. NAITASIRI: Plant Introduction and Quarantine Station, Nanduruloulou, *DA 10144*. FIJI without further locality, *DA 12974*.

28. *Echinochloa* Beauv. Ess. Nouv. Agrost. 53. 1812.

Annuals or perennials, coarse, often succulent grasses with compressed sheaths and linear, flat leaf blades; panicle somewhat compressed, made up of short, densely flowered racemes borne along a main axis; spikelets solitary or in irregular clusters along one side of raceme, subsessile, often stiffly hispid, the lower glume about half length of spikelet, pointed, the upper glume and sterile lemma often bearing a long awn, enclosing a membranous palea and sometimes also the ♂ flower, the fertile lemma smooth, shiny, the lower margins inrolled, the apex not enclosed.

LECTOTYPE SPECIES: *Echinochloa crusgalli* (L.) Beauv. (*Panicum crusgalli* L.) (ING).

DISTRIBUTION: About 30 species in the warmer regions of the world. Four introduced species have been recorded from Fiji and are naturalized and common.

KEY TO SPECIES

Ligule a fringe of stiff hairs, at least in the lower leaves; spikelets acuminate, 3–5 mm. long, purplish-tinged, long-awned. 1. *E. stagnina*

Ligule entirely absent.

Racemes thickened, sometimes incurved; spikelets densely crowded, 3–4 mm. long, lacking an awn; tall, robust grass. 2. *E. frumentacea*

Racemes rather distant; spikelets more or less hispidulous or hairy, 2.5–3 mm. long, the lower lemma and upper glume equally acute or cuspidate, not awned; small to medium-sized grass. 3. *E. colona*

Racemes ascending, close together; spikelets 3–4 mm. long, conspicuously hispid, the upper glume acuminate, cuspidate, the lower lemma long- to moderately long-awned; tall, moderately robust grass. 4. *E. crusgalli* subsp. *hispidula*

1. *Echinochloa stagnina* (Retz.) Beauv. Ess. Nouv. Agrost. 53. 1812; Greenwood in J. Arnold Arb. 25: 397. 1944, in op. cit. 30: 84. 1949; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 20: 17. 1949; J. W. Parham in Dept. Agr. Fiji Bull. 30: 69, fig. 26, II. 1956, Pl. Fiji Isl. 304. 1964, ed. 2. 401. 1972.

Panicum stagninum Retz. Obs. Bot. 5: 17. 1788.

Echinochloa crus-pavonis sensu B. E. V. Parham in Proc. 7th Pacific Sci. Congr. 5: 237. 1953; J. W. Parham in Dept. Agr. Fiji Bull. 30: 68. 1956, Pl. Fiji Isl. 304. 1964; non Schultes.

Annual, the culms erect, 60–120 cm. high; leaf blades 15–45 cm. long, 5–10 mm. broad; panicle erect, the racemes ascending or appressed, 1.8–5 cm. long; spikelets purplish-tinged, pubescent, 3–5 mm. long, the awns 1–4 mm. long.

TIPIFICATION: The original material was obtained in "India orientalis."

DISTRIBUTION: Tropical Asia and Africa, but now widespread. In Fiji it is naturalized and fairly common, but thus far I have not noted it elsewhere than on Viti Levu, from which more than 30 collections are available. Flowers have been noted from April through September.

LOCAL NAME AND USE: *Barnyard grass*. It is considered of no economic use, but rather a weed of rice fields, swamps, roadsides, and open places.

REPRESENTATIVE COLLECTIONS: VITI LEVU: NANDRONGA & NAVOSA: Singatoka, DA 2805. SERUA: Navua River, Greenwood 973; Ndeumba, DA 8635; Tokotoko road, Navua, DA 10559; Nakaulevu, Navua, DA 11443. NAMOSI: Wainandoi, DA 3091. RA: Ndombuilevu, DA 7872. NAITASIRE: Vinundawa, DA 8404; Approved School, Nasinu, DA 9116; Research Station, Koronivia, DA 3971; Nanduruloulou, DA 3558. REWA: Lokia, DA 8599; Nakaile, DA 8611; Notho, DA 1247; Suva Point, DA 7598.

2. *Echinochloa frumentacea* (Roxb.) Link. Hort. Reg. Bot. Berol. 1: 204. 1827; J. W. Parham, Pl. Fiji Isl. ed. 2. 401. 1972.

Panicum frumentaceum Roxb. Fl. Ind. 1: 304. 1820.

Echinochloa crusgalli var. *frumentacea* W. F. Wight in Suppl. Cent. Dict. 810. 1909; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 20: 17. 1949; J. W. Parham in Dept. Agr. Fiji Bull. 30: 68. 1956, Pl. Fiji Isl. 304. 1964.

Erect, robust grass 60–120 cm. high; leaf blades 15–35 cm. long, 5–8 mm. broad; racemes thick, incurved, appressed, 10–25 mm. long; spikelets crowded, pubescent, 3–4 mm. long, purple-tinged, the glumes and lemmas mucronate.

TYPIFICATION: Originally based on a cultivated specimen from India.

DISTRIBUTION: Tropical Africa, Asia, and America. It has become moderately common on Viti Levu but is not recorded from other Fijian islands, occurring near sea level in rice fields, swamps, and along roadsides. Flowering seems to be sporadic.

LOCAL NAMES AND USE: *Japanese barnyard grass*; *Japanese barnyard millet*. It is considered of no economic value but, indeed, is a minor weed.

AVAILABLE COLLECTIONS: VITI LEVU: RA: King's Road near Thamboni, *DA 9064*, NAITASIRE: Naithavuthavu, *DA 5610*.

3. *Echinochloa colona* (L.) Link, Hort. Reg. Bot. Berol. **2**: 209. 1833; Summerhayes & Hubbard in Kew Bull. **1927**: 36. 1927, in op. cit. **1930**: 258. 1930; Greenwood in J. Arnold Arb. **25**: 404. 1944; B. E. V. Parham in Agr. J. Dept. Agr. Fiji **20**: 16. 1949, in Proc. 7th Pacific Sci. Congr. **5**: 237, 251. 1953; J. W. Parham in Dept. Agr. Fiji Bull. **30**: 66. *fig.* 25. 1956, in op. cit. **35**: 162. *fig.* 85. 1959, Pl. Fiji Isl. **304**. 1964, ed. 2. 401. 1972.

Panicum colonum L. Syst. Nat. ed. 10. 870. 1759.

Culms prostrate to erect, 15–60 cm. high; leaf blades lax, occasionally with purple markings, 5–15 cm. long, 2.5–5 mm. broad; racemes several, distant, ascending to appressed, 1–2 cm. long; spikelets pubescent, almost sessile, 2–3 mm. long, the upper glume and sterile lemma equally acute or cuspidate, lacking an awn.

TYPIFICATION: The species was originally based on Jamaican material.

DISTRIBUTION: Widespread throughout the tropics of Asia and Africa and apparently of early occurrence in tropical America. In Fiji it occurs from sea level to about 200 m. in wet places such as rice fields, roadsides, river banks, shores of ponds, the inner edges of mangrove swamps, old clearings, etc. More than 100 Fijian collections exist in the world's herbaria. Flowers occur throughout the year.

LOCAL NAME AND USE: *Jungle rice*. It has no economic value but, on the contrary, is a common weed of cultivation.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Lautoka, *Greenwood 31A*; near Nandi airport, *DA 8249*; Nandarivatu road, *DA 8148*. NANDRONGA & NAVOSA: Lombau Farm, *DA 7999*. SERUA: Tokotoko, Navua, *DA 8661*. RA: District Farm, Ndombuilevu, *DA 7862*; Rewasa, *DA 8075*. NAITASIRE: Vinindawa, *DA 8402*; Ndavuilevu, *DA 426*; opposite Central Medical School, Tamavua, *DA 7534*. TALEVU: Londoni, *DA 7765*; Korovou, *DA 8460*. REWA: Koronggangga, *DA 307*; Waivou, *DA 7438*. KANDAVU: Ngaloa Island, *DA 9066*. NGAU: East of Herald Bay, inland from Sawaieke, *Smith 7968*. VANUA LEVU: MBUA: *DA 5022*. MATHUATA: Vicinity of Natua, Seanggangga Plateau, *Smith 6660*; banks of lower Lambasa River, *Smith 6633*; Muanindevo, Ndreketi, *DA 3128*. THAKAUNDROVE: Savusavu, *DA 8847*; hills south of Nakula Valley, *Smith 334*. TAVEUNI: Waitavala, *DA 8893*. RAMBI: *DA 5768*. WAILANGILALA: *DA 3454*. Summerhayes and Hubbard also record this species from the islands of Vatulele, Moturiki, Koro, Mbatiki, Moala, Matuku, Kanathea, Vanua Mbalavu, Nayau, Lakemba, and Kambara.

4. *Echinochloa crusgalli* subsp. *hispidula* (Retz.) Honda in J. Fac. Sci. Univ. Tokyo, Sect. 3, Bot. **3**: 267. 1930.

Panicum hispidulum Retz. Obs. Bot. **5**: 13. 1788.

Echinochloa crusgalli sensu B. E. V. Parham in Agr. J. Dept. Agr. Fiji **20**: 16. 1949, in Proc. 7th Pacific Sci. Congr. **5**: 237. 1953; J. W. Parham in Dept. Agr. Fiji Bull. **30**: 67. *fig.* 26, *l.* 1956, Pl. Fiji Isl. **304**. 1964, ed. 2. 401. 1972; non subsp. *crusgalli*.

Culms stout, erect to decumbent, 45–100 cm. high, usually branching at base; sheaths glabrous, the leaf blades 15–45 cm. long, 5–15 mm. broad; panicle erect, the racemes 1.8–3.6 cm. long; spikelets crowded, conspicuously hispid, the glumes mucronate, the lower lemma with an awn 10–15 mm. long, occasionally longer.

TYPIFICATION AND NOMENCLATURE: *Echinochloa crusgalli* (L.) Beauv. is based on *Panicum crusgalli* L., described from European material but also known to Linnaeus from American material. Presumably subsp. *hispidula* is more prevalent in the tropical Pacific than the typical subspecies.

DISTRIBUTION: Common in many subtropical and temperate areas. In Fiji it is more frequent than suggested by the few collections from Viti Levu cited below, occurring near sea level in rice fields, swampy places, and along roadsides. Flowering material may be found scattered throughout the year.

LOCAL NAME AND USE: *Barnyard grass*. The species is of little economic value but is a weed primarily of rice fields.

REPRESENTATIVE COLLECTIONS: VITI LEVU: SERUA: Ndeumba, DA 8632. NAITASIRE: Research Station, Koronivia, DA 3974; Nanduruloulou, DA 3562, 3577, 3579; Mbatiki, Nanduruloulou, DA 7522. TAILEVU: Wainivesi turnoff, DA 3096. REWA: Veisari, DA 11234; vicinity of Suva, Meebold 26533.

29. *Melinis* Beauv. Ess. Nouv. Agrost. 54. 1812.

Perennials, the culms slender, branching, decumbent; panicles narrow, many-flowered with small branchlets and pedicels; spikelets small, dorsally compressed, 1-flowered with sterile lemma below fertile floret, the rachilla disarticulating below glumes, the lower glume minute, the upper glume and sterile lemma similar, membranaceous, strongly nerved and slightly larger than fertile floret.

TYPE SPECIES: *Melinis minutiflora* Beauv. (ING).

DISTRIBUTION: Tropical and southern Africa and Madagascar, with one species in tropical America and the West Indies. About 18 species are usually recognized. One species was introduced into Fiji in 1934 for trial as a pasture and fodder grass and is now naturalized.

1. *Melinis minutiflora* Beauv. Ess. Nouv. Agrost. 54, t. 11, fig. 4. 1812; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 20: 18. 1949, in Proc. 7th Pacific Sci. Congr. 5: 238. 1953; J. W. Parham in Dept. Agr. Fiji Bull. 30: 100. 1956, Pl. Fiji Isl. 307. 1964, ed. 2. 405. 1972.

Perennial, the culms ascending from much-branched base, 60–150 cm. high; leaf blades viscid-pubescent, giving off strong odor of molasses when crushed or bruised; panicle purplish, the racemes ascending, 3–6 cm. long; spikelets purplish in color, 2–2.5 mm. long, the sterile lemma 2-lobed, bearing a fine awn 8–12 mm. long given off from between the lobes.

TYPIFICATION: The original description was based on Brazilian material.

DISTRIBUTION: A native of Africa, now widespread in other tropical countries as a fodder grass. It has escaped from the original trial plots in Fiji and is naturalized in one or two localities on Viti Levu, but is nowhere common. Flowering appears to be sporadic.

LOCAL NAME AND USE: *Molasses grass*. The species is palatable to stock.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Mba Closed Area plots, DA 14349. NANDRONGA & NAVOSA: Agricultural Station, Nathotholevu, Singatoka, DA 8318. NAITASIRE: Research Station, Koronivia, DA 3525; Plant Introduction and Quarantine Station, Nanduruloulou, DA 3526, 3615, 3617, 3659, 8009, 9170, 10139.

30. *Oplismenus* Beauv. Fl. Oware 2: 14. 1810; Seem. Fl. Vit. 324. 1868.

Annuals or perennials; freely branching, creeping, shade-loving grasses; leaf blades flat, thin, lanceolate or ovate; inflorescence erect, the racemes several, one-sided, fairly thick and short; spikelets somewhat laterally compressed, subsessile, solitary or in pairs, in 2 rows, crowded, on one side of narrow rachis; glumes approximately equal, awned from apex or from between lobes, the sterile lemma mucronate or with a short awn, enclosing a hyaline palea.

TYPE SPECIES: *Oplismenus africanus* Beauv. (ING).

DISTRIBUTION: Tropical and subtropical, with about 15 species. Three species are known from Fiji, and two of them, *Oplismenus compositus* and *O. imbecillis*, appear to have been very early, possibly aboriginal, introductions.

KEY TO SPECIES

- Racemes up to 6 cm. long, ascending, overlapping (i. e. longer than internode between them); spikelets alternate, somewhat distant, the awns smooth, filiform, stiff, often reddish-tinged. 1. *O. compositus*
 Racemes 1–1.5 cm. long, shorter than internode between them; spikelets crowded, the lower lemma awned. 2. *O. hirtellus*
 Racemes reduced to sessile, fascicled clusters of spikelets, less than 1 cm. long, distant on main axis of inflorescence, short-awned. 3. *O. imbecillis*

1. *Oplismenus compositus* (L.) Beauv. Ess. Nouv. Agrost. 168. 1812; Summerhayes & Hubbard in Kew Bull. 1927: 37. 1927, in op. cit. 1930: 259. 1930; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 20: 18. 1949; J. W. Parham in Dept. Agr. Fiji Bull. 30: 70. 1956, Pl. Fiji Isl. 307. 1964, ed. 2. 406. 1972.

Panicum compositum L. Sp. Pl. 57. 1753.

Perennial, the culms creeping, branching, 30–90 cm. long; leaf blades tapering to a fine point, 2.5–5 cm. long, 1.5–2.5 cm. broad; inflorescence bearing 5 or 6 ascending or spreading racemes, these up to 6 cm. long; spikelets not crowded, about 3.5 mm. long, the lower glume with a reddish-tinged awn 10–12 mm. long, the upper glume with an awn about 2 mm. long, the lower lemma mucronate.

TYPIFICATION: Linnaeus based his species on a plant from Ceylon.

DISTRIBUTION: Tropical regions of the Old and New Worlds. Apparently *Oplismenus compositus* was an early introduction to Fiji, now being fairly common from sea level to about 900 m. on open hillsides, river banks, beaches, and on plantations; it also occurs along forest trails and in wet, open places, sometimes forming dense tangles in crest clearings. Flowers have been noted from April through July. It is doubtless more common than suggested by the specimens cited below. No Fijian local names or uses have been recorded.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Northern portion of Mt. Evans Range, between Mt. Vatuyanitu and Mt. Natondra, *Smith* 4287. NANDRONGA & NAVOSA: Nausori Highlands, *DA* 12678 (*Melville et al.* 7055). NAMESE: Track to Mt. Voma, *DA* 1748. RA: District Farm, Ndombuilevu, *DA* 7802, 7875; Kavula District, *DA* 2906. NAITASIRI: Adi Cakobau School, Sawani, *DA* 7644; Naveisama-sama, *DA* 1217, 1218, 1219. TAILEVU: Wainivesi road, *DA* 7720; Wailotua Cave, *DA* 9421. REWA: Natuanuku Island, *DA* 9152. MBENGGA: *DA* 9617. NGAU: East of Herald Bay, inland from Sawaieke, *Smith* 7795, 7972. Summerhayes and Hubbard have also reported Tothill collections from the islands of Vatulele, Kandavu, Moturiki, Mbatiki, Nayau, Moala, and Lakemba.

2. *Oplismenus hirtellus* (L.) Beauv. Ess. Nouv. Agrost. 168, 170. 1812; Summerhayes & Hubbard in Kew Bull. 1927: 37. 1927, in op. cit. 1930: 258. 1930; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 20: 18. 1949; J. W. Parham in Dept. Agr. Fiji Bull. 30: 70. 1956, Pl. Fiji Isl. 307. 1964, ed. 2. 406. 1972.

Panicum hirtellum L. Syst. Nat. ed. 10. 870. 1759.

Perennial, the culms creeping; flowering culms erect, 15–30 cm. high; sheaths glabrous to densely papillose-hispid, the leaf blades 5–10 cm. long, 3–6 mm. broad; panicles bearing 3–7 ascending or spreading racemes, these 1–1.5 cm. long, shorter than internode between them; junction of pedicel and spikelet ciliate, the spikelets crowded, purplish-tinged, 2.5–3 mm. long, the lower glume with an awn 10–12 mm. long, the awn of the upper glume 2–3 mm. long.

TIPIFICATION: The original description is based on a plant from Jamaica.

DISTRIBUTION: Known throughout the tropical regions of the world. In Fiji it is moderately common, considerably more abundant than suggested by the collections cited below, occurring from sea level to about 600 m. on hillsides and the edges of forest; it is usually found in damp, shady places. There is a variegated form (with leaf blades white or sometimes purple-tinged and green) which is often grown as an ornamental in shady places. Flowers have been noted in May and July.

LOCAL NAME: *Basket grass*.

AVAILABLE COLLECTIONS: VITI LEVU: NANDRONGA & NAVOSA: Nausori Highlands, *DA 12630* (*Melville et al. 7001*); Korotonga, *DA 8004, 8005*. NAITASIRI: Tholo-i-suva, *DA 16765* (variegated form). TOTOYA: *DA 13245*. FIJI without further locality, *DA 3493*. Summerhayes and Hubbard also record Tothill collections from Vatulele, Koro, Mbatiki, Nairai, Ngau, Moala, Matuku, Kanathea, Vanua Mbalavu, Mango, Kambara, and Fulanga.

3. *Opismenus imbecillis* (R. Br.) Roemer & Schultes, *Syst. Veg.* 2: 487. 1817; Summerhayes & Hubbard in *Kew Bull.* 1927: 37. 1927, in op. cit. 1930: 259. 1930; J. W. Parham, *Pl. Fiji Isl.* 307. 1964.

Panicum undulatifolium Arduino, *Animadv. Bot. Spec. Alt.* 14. 1764.

Orthopogon imbecillis R. Br. *Prodr. Fl. Nov. Holl.* 194. 1810.

Opismenus undulatifolius Beauv. *Ess. Nouv. Agrost.* 54. 1812; A. C. Sm. in *Sargentia* 1: 6. 1942; J. W. Parham, *Pl. Fiji Isl.* 307. 1964, ed. 2. 406. 1972.

Opismenus sp. Seem. in *Bonplandia* 9: 261. 1861, Viti, 444. 1862.

Opismenus compositus sensu Seem. in *Bonplandia* 9: 261. 1861, Viti, 444. 1862, *Fl. Vit.* 324. 1868; non Beauv.

Opismenus burmanni sensu Seem. *Fl. Vit.* 324. 1868; C. H. Wright in *Dept. Agr. Fiji Bull.* 10: 3. 1918, in *Dept. Agr. Fiji Circ.* 3: 40. 1922; non Beauv.

Culms slender, creeping, 15–22 cm. high; leaf blades lanceolate, 2–8 cm. long, 3–8 mm. broad; racemes reduced, less than 1 cm. long, distantly placed on main axis of inflorescence; spikelets sessile or subsessile, about 3 mm. long, sparsely pubescent, the lower glume with an awn 6–8 mm. long, the upper glume with an awn about 2 mm. long, the lemma with a very short awn about 0.5 mm. long.

TIPIFICATION AND NOMENCLATURE: Brown's species is based on a plant from New South Wales, Australia. Apparently there is some question as to whether Arduino consistently employed binary nomenclature (ICBN, Art. 23); his prior specific epithet therefore may not be acceptable.

DISTRIBUTION: Recorded from Australia, the Philippines, and Malesia. The Seemann collections indicate that it was an early arrival in Fiji, where it is now fairly common, although not frequently collected. It occurs from sea level to about 900 m. on hillsides, in dry forest and often spreading along forest trails, and near villages. Flowers have been observed between February and July.

LOCAL NAMES: *Tho ndamu, tho luna, tho ndamundamu*.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Vicinity of Nandarivatu, *Degener 14384*. NAITASIRI: Adi Cakobau School, Sawani, *DA 7642*; Nasinu Training College Farm, *DA 8021*. TAILEVU: East of Wainimbuka River, vicinity of Ndakuivuna, *Smith 7037*; near Waisei Village, *DA L.15641*. VITI LEVU without further locality, *Seemann 679, 680*. MBENGGA: *DA 9615*. KANDAVU: C. R. Turbet s. n. OVALAU: Hills east of Lovoni Valley, *Smith 7318*. NGAU: Shores of Herald Bay near Sawaieke, *Smith 7925*. FIJI without further locality, *Seemann 681*.

31. *Panicum* L. Sp. Pl. 55. 1753, Gen. Pl. ed. 5. 29. 1754.

Annuals or perennials, with open or compact panicles; spikelets dorsiventrally compressed, the glumes 2, unequal, nerved, the lower one often minute, the upper one equal to the sterile lemma, the palea membranaceous or hyaline, borne in axil of sterile lemma and, occasionally, with a ♂ flower, the fertile lemma obtuse, with margins inrolled over enclosed palea of same texture.

LECTOTYPE SPECIES: *Panicum miliaceum* L. (ING).

DISTRIBUTION: A large genus of approximately 500 species in tropical and warm temperate areas. Three species appear to be sufficiently well established in Fiji to merit consideration, but only one, *Panicum maximum*, is widespread and common. Two previously recorded species (cf. J. W. Parham in Fiji Dept. Agr. Bull. 30: 57, 58. 1956), *P. bulbosum* H. B. K. (represented by DA 3089) and *P. prolutum* F. v. Muell. (represented by DA 3088), were known in Fiji only from trial plots, where they failed to survive.

KEY TO SPECIES

- Culms densely tufted; rhizomes spreading. 1. *P. maximum*
 Culms borne on creeping rootstocks or wiry, fibrous roots.
 Rootstock villous, hairy, stout, creeping, sending out many hairy extravaginal stolons; spikelets crowded, sometimes purple-tinged, the lower floret neuter. 2. *P. antidotale*
 Rootstock absent, the roots wiry or fibrous; stolons, if present, intravaginal; spikelets well spaced, the lower floret ♂ 3. *P. coloratum*

1. *Panicum maximum* Jacq. Icon. Pl. Rar. 1: 2. t. 13. 1781, Collect. 1: 76. 1787.

Perennial, densely tufted grass, the rhizomes spreading, the culms 22–180 cm. high; leaf blades glabrous with rough margins, 15–60 cm. long, 4–25 mm. broad; panicle loose to dense, with numerous, erect, spreading branches 7–12 cm. long and branchlets; spikelets alike, oblong, blunt, 3–4.5 mm. long, glabrous, 2-flowered with dissimilar florets, the upper one perfect, falling entire, the fertile lemma rugose.

DISTRIBUTION: Tropical Africa, but now widely distributed through many warm countries. Two varieties have been recorded from Fiji.

KEY TO VARIETIES

- Grass robust, up to 180 cm. high; spikelets oblong, with a blunt apex, the fertile lemma rugose, the glumes and sterile lemma glabrous. 1a. var. *maximum*
 Grass less robust, the culms rather slender, up to 60 cm. high; spikelets pale green, often purple-tinged, the upper glume and lower lemma loosely and softly pubescent. 1b. var. *trichoglume*

1a. *Panicum maximum* Jacq. var. *maximum*; J. W. Parham, Pl. Fiji Isl. ed. 2. 407. 1972.

Panicum maximum sensu C. H. Wright in Dept. Agr. Fiji Circ. 3: 40. 1922; Summerhayes & Hubbard in Kew Bull. 1927: 37. 1927, in op. cit. 1930: 259. 1930; Greenwood in Proc. Linn. Soc. 154: 106. 1943; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 20: 18. 1949, in Proc. 7th Pacific Sci. Congr. 5: 222. 236. 1953; J. W. Parham in Dept. Agr. Fiji Bull. 30: 54, fig. 20, pl. IV. 1956, in op. cit. 35: 156, fig. 83. 1959, Pl. Fiji Isl. 307. 1964.

Panicum decompositum sensu Summerhayes & Hubbard in Kew Bull. 1927: 37. 1927, in op. cit. 1930: 259. 1930; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 20: 18. 1949; J. W. Parham in Dept. Agr. Fiji Bull. 30: 56. 1956, Pl. Fiji Isl. 307. 1964; non R. Br.

The typical variety, with culms to 180 cm. high and leaf blades 6–25 mm. broad, the glumes and sterile lemma glabrous.

TYPIFICATION: Jacquin's species was based on material from the Lesser Antilles.

DISTRIBUTION: The typical variety of *Panicum maximum* was an early introduction into Fiji; it is now naturalized and widespread especially in the "intermediate" climatic zones of Fiji. It occurs from sea level to about 900 m. on hillsides, river

banks, sandy flats near beaches, and along roadsides. Flowers occur throughout the year. Sixty or 70 collections of this common grass are known in Fiji.

LOCAL NAME AND USES: *Guinea grass*. This is a very good pasture and fodder grass which, however, requires good management to prevent it from being eaten out. Unfortunately it is also a weed of sugarcane fields, roadsides, and river banks.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Near Lautoka, *DA 8210*; Nandarivatu road, *DA 8156*; vicinity of Nandarivatu, *Gillespie 4171*. NANDRONGA & NAVOSA: Agricultural Station, Nathotholevu, Singatoka, *DA 8296*; Lombau Farm, *DA 7985*. SERUA: Coastal strip in vicinity of Ngaloa, *Smith 9682*; Naitonitoni, *DA 2847*. NAMOSI: Wainilotulevu, *DA 9101*. RA: District Farm, Ndombuilevu, *DA 7871*; near Vaileka, *DA 8140*. NAITASIRI: Research Station, Koronivia, *DA 7456*; Plant Introduction and Quarantine Station, Nanduruloulou, *DA 9052*. TAILEVU: Natovi, *DA 7749*. REWA: King's Road, near Suva, *DA 5868*. VANUA LEVU: MATHUATA: Movo, *DA 8724*; Ndaku, *DA 8781*. TAVEUNI: Waiyevo, *DA 8943*. Summerhayes and Hubbard have also recorded this grass from the islands of Wakaya and Kanathea.

1b. *Panicum maximum* var. *trichoglume* Eyles ex Robyns in Mém. Inst. Roy. Colon. Belge, Sect. Sci. Nat. 1 (6): 31. 1932; J. W. Parham, Pl. Fiji Isl. ed. 2. 407. 1972.

A variety with rather slender culms up to 60 cm. high; leaf blades 20–35 cm. long, 4–6 mm. broad; upper glume and lower lemma loosely and softly pubescent.

TIPIFICATION: The variety is based on material from Victoria Falls, Africa.

DISTRIBUTION: A native of East Africa, var. *trichoglume* has been grown in other warm countries for trial as a pasture grass. It was first introduced into Fiji in 1950 and has been reported as an escape in several localities adjacent to the trial areas. Flowers have been noted in July and December.

LOCAL NAMES AND USE: *Guinea grass*; *green panic*. The variety is a promising pasture grass.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Mba Closed Area plots, *DA 13187*. NANDRONGA & NAVOSA: Agricultural Station, Nathotholevu, Singatoka, *DA 8299*. NAITASIRI: Plant Introduction and Quarantine Station, Nanduruloulou, *DA 3611, 3622, 3626*. FIJI without further locality, *DA 12977, FDA 15206* (presumably one of the original plant introduction numbers).

2. *Panicum antidotale* Retz. Obs. Bot. 4: 17. 1786; J. W. Parham in Dept. Agr. Fiji Bull. 30: 57. 1956, Pl. Fiji Isl. ed. 2. 406. 1972.

Perennial, with culms 75–120 cm. high; rootstock villous, hairy, stout, creeping, sending out hairy, extravaginal stolons; leaf blades 15–25 cm. long, 3–6 mm. broad, tapering to a fine point; spikelets crowded, often purple-tinged, glabrous, 2.5–3 mm. long, the lower floret neuter.

TIPIFICATION: The species is based on a collection by König from the Malabar coast, India.

DISTRIBUTION: India, Afghanistan, and Iran, but now on trial in other countries as a fodder grass. *Panicum antidotale* was first introduced into Fiji in 1934 but failed to persist. However, more recent introductions of 1953 are reported to be showing promise, and the species appears to have spread to areas adjacent to the trial plots and probably will become naturalized. Flowers have been noted in May, July, and August.

LOCAL NAME AND USE: *Texas grass*. It is considered to be a promising pasture grass.

AVAILABLE COLLECTIONS: VITI LEVU: NANDRONGA & NAVOSA: Agricultural Station, Nathotholevu, Singatoka, *DA 8569, 11310*. RA: District Farm, Ndombuilevu, *DA 10152*. NAITASIRI: Plant Introduction and Quarantine Station, Nanduruloulou, *DA 8336, 8337*.

3. *Panicum coloratum* L. Mant. Pl. 30. 1767; J. W. Parham, Pl. Fiji Isl. ed. 2. 406. 1972.

Perennial and caespitose, the culms 75–90 cm. high; roots wiry, fibrous, the stolons intravaginal when present; leaf blades 20–45 cm. long, 5–10 mm. broad, tapering to a fine point; spikelets well spaced on panicle branches, often purple in color, glabrous, 3–4 mm. long, the lower floret δ .

TIPIFICATION: The original material came from Egypt.

DISTRIBUTION: Tropical Africa, but introduced to other parts of the world including Fiji, where it has been on trial since 1955 and is showing promise as a fodder grass. It is reported to have spread in areas adjacent to trial plots and will doubtless become naturalized. Flowers have been noted only in May.

AVAILABLE COLLECTIONS: VITI LEVU: NAITASIRI: Research Station, Koronivia, DA 7455. FIJI without further locality, DA 12975, FDA 15206 (plant introduction number).

32. *SETARIA* Beauv. Ess. Nouv. Agrost. 51, 178. 1812. Nom. cons.

Annuals or perennials; panicles terminal, narrow, very dense and spikelike, sometimes loose to open; spikelets subtended by one to several to numerous bristles, lacking an awn, the lower glumes broad, about half length of spikelet, 3–5-nerved, the upper lemma and sterile lemma equal, the fertile lemma smooth or transversely rugose.

TYPE SPECIES: *Setaria viridis* (L.) Beauv. (*Panicum viride* L.). Typ. cons. (ICBN; ING).

DISTRIBUTION: Tropical and warm temperate countries, with about 140 species. Considerable confusion over the identity of the one very common species in Fiji has resulted in the recording of several more "species" than are actually to be found in the archipelago. It is now clear that only three species are known from Fiji, and of these only two are common.

Setaria glauca has at various times been listed in publications dealing with the Fijian flora under the names *S. pallidifusca*, *S. geniculata*, *S. lutescens*, and *S. verticillata*. An attempt is herewith made to sort out the misidentifications and erroneous records so that the superfluous names may be accounted for and eliminated from the Fijian record.

It should also be noted that *Setaria sphacelata* (Schum.) Stapf & Hubbard was introduced for trial in 1955 and, although reported as showing some promise (cf. J. W. Parham, Pl. Fiji Isl. ed. 2. 411. 1972), it has not been recorded as being established and it will probably not become naturalized. It is represented in herbaria by DA 9813, 10838, 12973, and 15388.

KEY TO SPECIES

- Inflorescence spicate, the spikelets solitary in the involucre surrounded by yellowish or rufous bristles; leaf blades narrow; spikelets about 3 mm. long. 1. *S. glauca*
 Inflorescence a rather loose, narrow, or widely spreading panicle; leaf blades with marked longitudinal nerves.
 Leaf blades broad, up to 6 cm. broad; panicle very lax, the inflorescence large, up to 50 cm. long and 20 cm. broad; spikelets about 3 mm. long, the bristle below spikelet not more than twice as long as spikelet; perennial grass. 2. *S. palmifolia*
 Leaf blades up to 2 cm. broad; branches of panicle divided from base and bearing short racemes; spikelets elliptic, acute, crowded, the upper glume half to three-quarters length of upper lemma, the lower floret δ or barren; annual grass. 3. *S. barbata*

1. *Setaria glauca* (L.) Beauv. Ess. Nouv. Agrost. 178. 1812; C. H. Wright in Dept. Agr. Fiji Circ. 3: 40. 1922; Summerhayes & Hubbard in Kew Bull. 1927: 38. 1927; J. W. Parham, Pl. Fiji Isl. 310. 1964. FIGURE 75.

Panicum glaucum L. Sp. Pl. 56. 1753.

Panicum pallide-fuscum Schumacher, Beskr. Guin. Pl. 58. 1827.

Setaria pallidifusca Stapf & Hubbard in Kew Bull. 1930: 259. 1930; Greenwood in J. Arnold Arb. 30: 84. 1949; J. W. Parham in Dept. Agr. Fiji Bull. 30: 63. 1956, in op. cit. 35: 162. 1959, Pl. Fiji Isl. 310. 1964, ed. 2. 410. 1972.

Setaria geniculata sensu A. C. Sm. in Sargentia 1: 6. 1942; Greenwood in J. Arnold Arb. 30: 84. 1949; J. W. Parham, Pl. Fiji Isl. 310. 1964; non Beauv.

Setaria lutescens sensu B. E. V. Parham in Agr. J. Dept. Agr. Fiji 20: 19. 1949; J. W. Parham in Dept. Agr. Fiji Bull. 30: 64, fig. 24. 1956, in op. cit. 35: 162, fig. 84. 1959; non Hubbard.

Setaria verticillata sensu B. E. V. Parham in Agr. J. Dept. Agr. Fiji 20: 19. 1949; J. W. Parham in Dept. Agr. Fiji Bull. 30: 65. 1956, Pl. Fiji Isl. 311. 1964; non Beauv.

Setaria glauca var. *pallide-fusca* T. Koyama in J. Jap. Bot. 37: 237. pl. 1. 1962.

Annual, in tufted clumps, the culms slender, 15–75 cm. high; leaf blades linear or linear-lanceolate, 5–30 cm. long, 3–10 mm. broad, glabrous or with some long white hairs toward base on upper surface; spike erect, cylindric, golden-brown in color, 1–15 cm. long, 6–12 mm. broad; spikelets broadly oblong, 3–3.5 mm. long, the upper lemma rugose; spikelets subtended by 4–12 bristles in each involucre, these 3–10 mm. long, finely antrorsely scabrous.

TYPIFICATION AND NOMENCLATURE: For *Panicum glaucum*, Linnaeus cited several prior references and then indicated: “*Habitat in Indiis.*” The other basionym concerned, *Panicum pallide-fuscum*, was based on a collection from Guinea, Africa. In making their new combination in 1930, Stapf and Hubbard altered the spelling of the epithet, in accord with the suggestions of ICBN, Art. 73 and Reccs. 23B and 73G. As discussed below, I have reached the decision to combine these two concepts only after an exhaustive study of Fijian and other Pacific representatives.

DISTRIBUTION: Warmer parts of the north temperate zone of the Old World, but now widely distributed in America, Australia, and the tropical areas of the Old World. In Fiji it is a very common grass (about 100 collections being available), found from sea level to an elevation of several hundred meters along roadsides and tracks, in cultivated areas such as rice fields, on dry open hillsides and open rocky places, in swampy areas, and on the inner edges of mangrove swamps. Flowers are to be expected in any month.

LOCAL NAMES AND USE: *Cat's tail grass*, *yellow bristle grass*, *mongoose tail grass*, *burr bristle grass*. It has no economic value but is a weed of cultivation and waste places.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Nandarivatu, *Gillespie 4150.1, DA 2349*; Sambeto Valley, *DA 8278*. NANDRONGA & NAVOSA: Lombau Farm, Singatoka Valley, *DA 7996*; Yanutha Island, *DA 9028*. SERUA: Ngaloa Village, *Smith 9455*; Naitonitoni, *DA 8649*, RA: Ndombuilevu, *DA 7317, 7800*; Rakiraki, *DA 7944*; Narewa, *DA 8129*. NAITASIRI: Vunindawa, *DA 7789*; Nawanggambena, *DA 730*; Navuso, *DA 3637*; Wainimbuku, *DA 8691*; Nasinu Training College Farm, *DA 9346*; near Nasinu, *Gillespie 3607*. TALEVU: Matavatathou, *DA 7776*; Viwa Farm, *DA 7684*; Wainivesi, *DA 7728*; Adi Cakobau School Farm, Sawani, *DA 7647*. REWA: Vicinity of Suva, *Degener & Ordenez 13514, DA 9088*; Nakaila, *DA 8610*. KANDAVU: Ngaloa Island, *DA 9071*. OVALAU: *Bryan 609*. VANUA LEVU: MATHUATA: Banks of lower Lambasa River, *Smith 6631*; Tambia, *DA 8744*; Tambuthola, *DA 8731*. THAKAUNDOVE: Vunimoli, *DA 8858*. TAVEUNI: Vicinity of Waiyevo, *Smith 8125, DA 8909*; Waitavala, *DA 8901*. NGGAMEA: *DA 8984*. VANUA MBALAVU: Near Lomaloma, *Garnock-Jones 1011*.

In Fiji, as in other parts of the world where this species occurs, there has been considerable confusion over its identity; five different names have, at one time or another, appeared in the literature pertaining to Fiji. A careful examination of the available Fijian specimens, and also of many occurring from southeastern Asia and

FIGURE 75. *Setaria glauca*; A, portion of plant with inflorescences bent back on stem, $\times 1/2$; B, spike, $\times 1$; C, portion of inflorescence, $\times 20$; D, spikelet, $\times 30$; A, C, & D from *Smith 8125*, B from *Smith 6631*.



Japan to Australia and Tonga, convinces me that only one species, *Setaria glauca*, can be accepted. Some of the "differences" noted in the past have more than likely been due to the stage of maturity at which the inflorescence has been observed. The differences used by some agrostologists to distinguish between *S. glauca* and *S. pallidifusca* are vague and difficult to interpret, and I do not find them to be of any real consequence. Koyama's recognition of *S. pallidifusca* at the varietal level does nothing to clarify the problem; the differences utilized by him (cf. Koyama in E. H. Walker, Fl. Okinawa and So. Ryukyu Isl. 210. 1976) are inconsequential and bear on different stages of maturity.

2. ***Setaria palmifolia*** (König) Stapf in J. Linn. Soc. Bot. **42**: 186. 1914; B.E.V. Parham in Agr. J. Dept. Agr. Fiji **20**: 19. 1949; J.W. Parham in Dept. Agr. Fiji Bull. **30**: 65. 1956, Pl. Fiji Isl. 311. 1964, ed. 2. 411. 1972.

Panicum palmaefolium König in Naturforscher (Halle) **23**: 208. 1788.

Perennial, the culms 1.5–2 m. high; sheaths papillose-hispid, the leaf blades plicate, flat, elliptic, pubescent, up to 60 cm. long and 6 cm. broad; panicle loose, open, up to 50 cm. long and 20 cm. broad, compound, the branches 1–15 cm. long; spikelets lanceolate, acute, 2.5–3 mm. long, on short branchlets appressed along the main branches, the subtending bristles few, about 6 mm. long.

TIPIFICATION: The original material was obtained in Siam.

DISTRIBUTION: Tropics of the Old World, now introduced as an ornamental grass in many other parts of the world. This shade-loving grass is not common in Fiji but it is naturalized in places in the vicinity of Suva. Flowers have been noted in April and September.

LOCAL NAME AND USE: *Palm grass*. Occasionally grown as an ornamental.

AVAILABLE COLLECTIONS: VITI LEVU: REWA: Pender Street, Suva, DA 2538, B.E.V. Parham 10873 (CHR 181988).

3. ***Setaria barbata*** (Lam.) Kunth, Rév. Gram. 47. 1829; Summerhayes & Hubbard in Kew Bull. **1930**: 260. 1930; Greenwood in J. Arnold Arb. **30**: 84. 1949; B.E.V. Parham in Agr. J. Dept. Agr. Fiji **20**: 19. 1949; J.W. Parham in Dept. Agr. Fiji Bull. **30**: 63. 1956, in op. cit. **35**: 162. 1959, Pl. Fiji Isl. 310. 1964, ed. 2. 410. 1972.

Panicum barbatum Lam. Tabl. Encycl. Méth. Bot. **1**: 171. 1791.

Annual, the culms slender, up to 60 cm. high; sheaths hairy, the leaf blades narrow, lanceolate, 7.5–25 cm. long, 6–20 mm. broad, pilose along nerves; panicle loose, 7.5–25 cm. long, about 4 cm. broad, the branches ascending, 0.5–2.5 cm. long; spikelets alike, oblong to ovate, 2.5–3 mm. long, 2-flowered, the upper floret perfect, awnless, each usually subtended by a single bristle about 10 mm. long.

TIPIFICATION: Lamarck's species is based on material from Mauritius.

DISTRIBUTION: Tropical Asia, Africa, and America. In Fiji it was first obtained in 1927 on the island of Koro by the Tothills. It is a moderately common grass in Fiji, occurring from sea level to about 200 m., often sprawling or scrambling on shrubs in thickets, forest clearings, plantations, and along roadsides in damp, shaded places. Flowering seems to be sporadic throughout the year.

LOCAL NAME: *Mary grass*.

AVAILABLE COLLECTIONS: VITI LEVU: REWA: Suva and vicinity, Degener & Ordonez 13515, DA 8676, 8977. OVALAU: Levuka, DA 1365. KORO: Nambasovi, DA 988. VANUA LEVU: DA 3660. THAKAUNDOVE: Nakava, DA 5691; Savusavu, DA 9631. TAVEUNI: Vicinity of Waiyevo, Smith 8124, DA 8939; Vindola, DA 8873; Waitavala, DA 8902. VANUA MBALAVU: Lomaloma and vicinity, Smith 1422, DA 10209.

33. *CYRTOCOCCUM* Stapf in Prain, Fl. Trop. Afr. 9: 745. 1920.

Annuals or perennials; spikelets usually arranged in open panicles; spikelets distinctly swollen on one side and much compressed laterally.

TYPE SPECIES: No type or lectotype species is yet indicated by the ING card.

DISTRIBUTION: Paleotropical, with about twelve species. Two are common in shady places throughout Fiji and are presumed to have been aboriginal introductions.

KEY TO SPECIES

Leaf blades elliptic, acute, linear, or lanceolate, mostly 2.5–3 cm. long, occasionally 6 cm. long; branches of the panicle glabrous; spikelets hispidulous. 1. *C. trigonum*

Leaf blades oblong-elliptic or lanceolate, acuminate, usually more than 10 cm. long; branches of panicle sometimes sparsely pilose; spikelets glabrous. 2. *C. oxyphyllum*

1. *Cyrtococcum trigonum* (Retz.) A. Camus in Bull. Mus. Hist. Nat. 27: 118. 1921; J. W. Parham in Dept. Agr. Fiji Bull. 30: 60. fig. 22, II. 1956, Pl. Fiji Isl. 303. 1964, ed. 2. 399. 1972.

Panicum trigonum Retz. Obs. Bot. 3: 9. 1783; A. C. Sm. in Sargentia 1: 6. 1942.

Annual, the culms branching, slender, semiprostrate; flowering culms 2.5–30 cm. high; panicle few-flowered, open to contracted, 1.2–5 cm. long, the ascending side branches 6–12 mm. long; spikelets laterally compressed, more or less strongly pilose, 1.5–2 mm. long, the upper glume keeled.

TIPIFICATION: The species is presumably based on material from India.

DISTRIBUTION: Southeastern Asia. In Fiji it is fairly common, probably more so than implied by the collections below cited; it occurs from sea level to about 600 m. in coastal thickets, light forest, waste places, pastures, coconut plantations, and old gardens, usually preferring shady places. Flowers are found in several months scattered throughout the year. No local names or uses have been recorded in Fiji.

AVAILABLE COLLECTIONS: VITI LEVU: SERUA: Ndeumba, DA 9194; Waimate beach, DA 10114. NAMOSI: Wainandoi River, DA 8368. VANUA LEVU: THAKAUNDROVE: Mbalanga Estate, DA 8814; Marava Estate, DA 8828; Valethi, DA 8860; Maravu, near Salt Lake, Degener & Ordenez 14149; Ndevo Estate, DA 9621; Wainigata, DA 12050; Ndromoninuku, DA 16826. TAVEUNI: Vicinity of Waiyevo, Smith 8118, DA 8908; slopes of Mt. Manuka, east of Wairiki, Smith 8313; Ngqathavulo Estate, DA 8886; near Matei, DA 8936.

2. *Cyrtococcum oxyphyllum* (Hochst. ex Steudel) Stapf in Hook. Icon. Pl. 31: sub t. 3096. 1922; Summerhayes & Hubbard in Kew Bull. 1927: 38. 1927, in op. cit. 1930: 259. 1930; Greenwood in J. Arnold Arb. 30: 84. 1949; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 20: 16. 1949; J. W. Parham in Dept. Agr. Fiji Bull. 30: 59. fig. 22, I. 1956, Pl. Fiji Isl. 303. 1964, ed. 2. 399. 1972.

Panicum oxyphyllum Hochst. ex Steudel, Syn. Pl. Glum. 1: 65. 1853; A. C. Sm. in Sargentia 1: 5. 1942.

Panicum pilipes sensu Seem. in Bonplandia 9: 261. 1861, Viti, 444. 1862; non Nees.

Panicum trigonum sensu Seem. Fl. Vit. 325. 1873; non Retz.

Perennial, the culms ascending from a slender creeping base, 15–45 cm. high; leaf blades 2.5–10 cm. or more long, 3–12 mm. broad; panicle dense, narrow, 2.5–10 cm. long, the branches ascending to erect, 1.5–3.8 cm. long; spikelets alike, asymmetrical, compressed, glabrous, awnless, falling entire, 1.5–2 mm. long, light brown in color.

TIPIFICATION: The original material came from the East Indies. Summerhayes and Hubbard indicated Seemann's misidentification of the specimens available to him.



DISTRIBUTION: Indo-Malesia, Australia, and Polynesia; obviously a very early introduction into Fiji. It is common, with about 40 known Fijian collections, in damp, shady places from sea level to about 1,200 m., usually in forest or on its edges, but it is also recorded from coconut plantations, along forest trails, and in clearings. Flowers have been noted throughout the year.

LOCAL NAMES AND USE: *Thovatu, osalasala*. No economic use has been noted, but the species is a minor weed of coconut plantations.

REPRESENTATIVE COLLECTIONS: YASAWAS: WAYA: North of Yalombi, *St. John 18127*. VITI LEVU: MBA: Mt. Evans Range between Mt. Vatuyanitu and Mt. Natondra, *Smith 4283*. NANDRONGA & NAVOSA: Vicinity of Mbolo, near Vatukarasa, *Degener 15231*. NAMOSI: Mt. Voma, *DA 13981*. NAITASIRE: Naulawai, *Vunindawa, DA 8416*; Tholo-i-suva, *DA 1611*. TAILEVU: East of Wainimbuka River, near Ndakui-vuna, *Smith 7147*. REWA: Mt. Korombamba, *DA 16528*; vicinity of Suva, *Meebold 17098*. KANDAVU: Ngaloa Island, *DA 9067*. "OVALAU and VANUA LEVU:" *U.S. Expl. Exped., Seemann 693*. NGAU: *MacGillivray s.n.*; shore of Herald Bay, near Sawaieke, *Smith 7922*. VANUA LEVU: MATHUATA: Near Lambasa, *Greenwood 165A*; Ndaku road, *DA 8795*. THAKAUNDROVE: Savusavu Bay region, between Mbalanga and Valethi, *Degener & Ordenez 14037*; near Mbutha, Mbutha Bay, *DA 16880*. Summerhayes and Hubbard record *Cyrtococcum oxyphyllum* from the additional islands of Moturiki, Koro, Mbatiki, Moala, Totoya, Matuku, Naitamba, Vanua Mbalavu, and Mango.

34. STENOTAPHRUM Trin. Fund. Agrost. 175. 1820.

Annuals or perennials, creeping, stoloniferous; leaf blades short, broad; flowering culms short, the racemes terminal and axillary; spikelets embedded in one side of an enlarged, flattened, corky rachis, slightly disarticulating toward tip at maturity, the spikelet remaining attached at joints; lower glume small, the upper glume and sterile lemma approximately equal, the lemma with a palea or ♂ flower.

TYPE SPECIES: *Stenotaphrum glabrum* Trin., nom. illeg. (*Panicum dimidiatum* L.: *S. dimidiatum* (L.) Brongn.) (ING).

DISTRIBUTION: The genus is composed of about seven tropical and subtropical species, of which two are recorded from Fiji.

KEY TO SPECIES

- Leaf blades lanceolate, finely pointed; spikes slender, the rachis 1–1.5 mm. broad; spikelets 2–2.5 mm. long. 1. *S. micranthum*
 Leaf blades narrow, blunt; spikes stout, the rachis 2–3 mm. broad; spikelets 3–4.5 mm. long. 2. *S. secundatum*

1. *Stenotaphrum micranthum* (Desv.) Hubbard in Hubbard & Vaughan, Grasses of Rodriguez and Mauritius, 73. 1940; J. W. Parham, Pl. Fiji Isl. ed. 2. 412. 1972.

FIGURE 76A & B.

Ophiurinaella micrantha Desv. Opusc. Sci. Phys. Nat. 75. t. 5, fig. 4. 1831.

Stenotaphrum subulatum Trin. in Mém. Acad. Imp. Sci. Saint-Petersbourg, Sér. 6, Sci. Math., Seconde Pt. Sci. Nat. 3: 190. 1835; Summerhayes & Hubbard in Kew Bull. 1927: 35. 1927, in op. cit. 1930: 258. 1930; J. W. Parham in Dept. Agr. Fiji Bull. 30: 73. 1956, Pl. Fiji Isl. 312. 1964.

Culms tufted, erect or ascending from a short, creeping base, up to 45 cm. high, the nodes prominent; sheaths slightly compressed, loose, the leaf blades lanceolate, finely pointed, 2.5–12.5 cm. long, 5–12 mm. broad; spikes slender, cylindrical, 2.5–15 cm. long; spikelets 2–4 together, sunken in cavities on rachis, oblong to oblong-lanceolate, obtuse, 2–2.5 mm. long.

TIPIFICATION AND NOMENCLATURE: Desvaux based his species on material from

FIGURE 76. A & B, *Stenotaphrum micranthum*, from *DA 10271*; A, apical portion of plant and inflorescence, × 1/2; B, detail of spike, × 8. C & D, *Stenotaphrum secundatum*, from *Smith 9612*; C, apical portion of plant and inflorescences, × 1/2; D, detail of spike, × 8.

La Réunion Island, Mascarene Islands. *Stenotaphrum subulatum* was described from specimens obtained in the Ladrone and Marianna Islands.

DISTRIBUTION: Mascarene Islands to Malesia, Micronesia, and Polynesia. It was first reported from Fiji in 1927 as moderately common (in spite of the paucity of material seen), occurring in sandy, coastal areas. Flowers have been noted in July and September.

USE: *Stenotaphrum micranthum* is probably useful as a sand binder.

AVAILABLE COLLECTIONS: VITI LEVU: NANDRONGA & NAVOSA: Near Thuvu, *DA 10271*. SERUA: Ndeumba, *DA 9008*. Summerhayes and Hubbard also record this species from the islands of Leleuvia (south of Moturiki), Mbatiki, Ngau, Namenalala (south of Vanua Levu, Province of Mbua), Totoya, Matuku, Vanua Mbalavu, Thikombia-i-lau, Lakemba, Kambara, and Fulanga.

2. *Stenotaphrum secundatum* (Walter) Kuntze, Rev. Gen. Pl. 2: 794. 1891; Summerhayes & Hubbard in Kew Bull. 1927: 35. 1927, in op. cit. 1930: 257. 1930; Greenwood in J. Arnold Arb. 25: 404. 1944; B.E.V. Parham in Agr. J. Dept. Agr. Fiji 20: 20. 1949; J.W. Parham in Dept. Agr. Fiji Bull. 30: 71. fig. 27. 1956, in op. cit. 35: 163. fig. 86. 1959, Pl. Fiji Isl. 312. 1964, ed. 2. 412. 1972.

FIGURE 76C & D.

Ischaemum secundatum Walter, Fl. Carol. 249. 1788.

Perennial, the culms branching, compressed, 20–30 cm. high; leaf blades 10–20 cm. long, 2.5–5 mm. broad, glabrous, folded or flat; spikes flattened, stout; spikelets solitary or in pairs, occasionally in threes, sessile, awnless, falling entire.

TYPIFICATION: Walter's original material came from South Carolina, U.S.A.

DISTRIBUTION: Tropical America and Africa; now widespread as a pasture and lawn grass. It was doubtless an early introduction into Fiji, first noted as being naturalized by Greenwood in 1926. It is moderately common from sea level to about 850 m., on the upper part of beaches, on waste land, and along roadsides. Flowers have been noted in months scattered throughout the year.

LOCAL NAMES AND USE: *Buffalo grass*, *St. Augustine grass*. Although it is elsewhere considered a useful pasture and lawn grass, in Fiji it is regarded as a weed of roadsides, etc.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Nandarivatu, *DA 2103, 17332*. SERUA: Coastal strip in vicinity of Ngaloa, *Smith 9612*. RA: Nanukuloa, *DA 3007*. TAILEVU: Lawaki, *DA 1667*. KANDAVU: C.R. Turbet 1. VANUA LEVU: THAKAUNDROVE: Nakama, Savusavu, *DA 5704*; Marava Estate, *DA 8830*. TAVEUNI: Vatuwiri, *DA 8916*. VANUA MBALAVU: Sawana, Lomaloma, *DA 10230*. Summerhayes and Hubbard also record Tothill collections from the islands of Kanathea and Mango.

35. *THUAREA* Pers. Syn. Pl. 1: 110. 1805; Seem. Fl. Vit. 323. 1868.

Annuals or perennials; flowering spike partially or wholly enclosed in topmost leaf; spikelets lacking bristle and awn.

TYPE SPECIES: *Thuarea sarmentosa* Pers. (ING).

DISTRIBUTION: Two coastal species, one in Madagascar and one in Indo-Malesia, *Thuarea involuta*, which occurs on beaches throughout Fiji.

1. *Thuarea involuta* (Forst. f.) R. Br. ex Roemer & Schultes, Syst. Veg. 2: 808. 1817; Seem. Fl. Vit. 323. 1868; Summerhayes & Hubbard in Kew Bull. 1927: 39. 1927, in op. cit. 1930: 261. 1930; J.W. Parham in Dept. Agr. Fiji Bull. 30: 106. 1956, Pl. Fiji Isl. 312. 1964, ed. 2. 412. 1972.

Ischaemum involutum Forst. f. Fl. Ins. Austr. Prodr. 73. 1786.

Perennial, the culms prostrate, creeping, branching; leaf blades glabrous, narrowly lanceolate, 2.5–10 cm. long, 5–10 mm. broad; spike terminal, 1.2–2.5 cm. long,

enclosed in a leafy bract; spikelets lacking awns, pubescent, falling entire, 4–5 mm. long, the lower 1 or 2 either ♀ or perfect, the upper 4–6 ♂; grain enclosed by thick, wide base of spike axis, forming a hard, false, watertight fruit about 1 cm. long.

TYPIFICATION: A lectotype should be chosen from the Cook Expedition specimens. The type locality is Tahiti, Society Islands.

DISTRIBUTION: Indo-Malesia and into Polynesia; it is common on beaches throughout Fiji. Flowers have been noted in months scattered throughout the year.

USE: No local names have been recorded, but the widely creeping stems of this prostrate grass act as very efficient sand binders.

AVAILABLE COLLECTIONS: VITI LEVU: NANDRONGA & NAVOSA: Singatoka beach, *Greenwood* 271. SERUA: Coastal strip in vicinity of Ngaloa, *Smith* 9508; Nggaraninggio beach, *DA* 1373; Ndeumba, *DA* 8621; Waimate beach, *DA* 10118; Naitonitoni, Navua, *DA* 8645, 8693. KANDAVU: *C. R. Turbet* 9, 31. VANUA LEVU: MATHUATA: *U.S. Expl. Exped.* THAKAUNDROVE: Nasinu, Natewa Bay, *DA* 16842. TAVEUNI: Waiyevo, *DA* 5731; Waitavala, *DA* 8889. VANUA MBALAVU: Sawana, Lomaloma, *DA* 13262. ONEATA: *U.S. Expl. Exped.* FIJI without further locality, *DA* 5052. Summerhayes and Hubbard also record Tothill collections from the islands of Vatulele, Leleuvia (south of Moturiki), Koro, Mbatiki, Nairai, Ngau, Totoya, Matuku, Wailangilala, Kanathea, Thikombia-i-lau, Mango, Nayau, Lakemba, Kambara, and Fulanga.

It is interesting to note that soon after anthesis the inflorescence-bearing shoots bend at the nodes, so that the ripening fruit of the inflorescence becomes buried in the sand. The ripening fertile spikelet becomes enclosed between the broadest part of the axis and the peduncle, with the result that the caryopsis is encased in the watertight compartment. If these "fruits" are washed out to sea they are capable of floating; this, together with the considerable length of time over which the seed retains its viability, enables the seed to be carried to distant shores where it can germinate.

36. *CENCHRUS* L. Sp. Pl. 1049. 1753, Gen. Pl. ed. 5. 470. 1754; Seem. Fl. Vit. 324. 1868.

Annuals, occasionally perennials; leaf blades flat; racemes of burrs, these readily deciduous; spikelets either solitary or a few together, enclosed by a spiny burr of numerous fused bristles; burr subglobular, short-stalked, falling with spikelets and permanently surrounding them, the spines of burr generally retrorsely barbed.

LECTOTYPE SPECIES: *Cenchrus echinatus* L. (ING).

DISTRIBUTION: Tropical and warm temperate areas, with about 25 species. Some species are considered to be useful pasture grasses while others, because of the burrs, are serious pests. Three species are known from Fiji.

KEY TO SPECIES

- Bristles fine, closely appressed, not or hardly thickened at base, 1. *C. calyculatus*
 Bristles stout, rigid, comparatively few, spreading, much thickened at base, forming a deep cup. 2. *C. echinatus*
 Bristles (at least inner ones) not very stout at base, ciliate on margins, not more than 1.5 cm. long; base of involucre small, naked. 3. *C. ciliaris*

1. *Cenchrus calyculatus* Cav. Icon. Descr. Pl. 5: 39. t. 463, as *C. caliculatus*. 1799; Summerhayes & Hubbard in Kew Bull. 1927: 39. 1927, in op. cit. 1930: 261. 1930; B.E.V. Parham in Agr. J. Dept. Agr. Fiji 20: 15. 1949; J.W. Parham in Dept. Agr. Fiji Bull. 30: 108. 1956, Pl. Fiji Isl. 301. 1964, ed. 2. 398. 1972.

FIGURE 77A.

Cenchrus anomoplexis Labill. Sert. Austro-Cal. 14. pl. 19. 1824; Seem. in Bonplandia 9: 261. 1861, Viti, 444. 1862, Fl. Vit. 324. 1868.

Annual, the culms stout, spreading or erect, up to 2 m. high, the nodes prominent; leaf blades narrowly lanceolate, 22–45 cm. long, 12–20 mm. broad, glabrous, tapering to a fine point; raceme spikelike, 7.5–25 cm. long; spikelets alike, lacking awns, borne in clusters on pedicels 1.5–3 mm. long, each cluster surrounded by hard, slender, yellow or pink-tinged spines, these joined at base into a hard cup, the innermost spines densely hairy.

TIPIFICATION AND NOMENCLATURE: Cavanilles based his species on material from the "Pacific Islands." The type of *Cenchrus anomoplexis* is from New Caledonia.

DISTRIBUTION: Pacific islands, probably from New Caledonia and Micronesia eastward. In Fiji it was first recorded by Seemann; it is moderately common in coastal areas on the outlying islands, but it has also been collected in crest thickets of the Mt. Evans Range at about 900 m. Flowers have been noted between February and July. No Fijian local names or uses are recorded.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Northern portion of Mt. Evans Range, between Mt. Vatuyanitu and Mt. Natondra, *Smith* 4292. TAILEVU: Matavatathou, *DA* 7758. OVALAU: *Seemann* 688. KORU: East coast, *Smith* 1104. NGAU: Shore of Herald Bay near Sawaieke, *Smith* 7942. VANUA LEVU: MATHUATA: Along coast, *Greenwood* 664. THAKAUNDROVE: Thavanandi, *DA* 10764. Summerhayes and Hubbard have also recorded this species from the islands of Vatulele, Wakaya, Mbatiki, Nairai, Taveuni, Totoya, Matuku, Vanua Mbalavu, Mango, Kambara, and Fulanga.

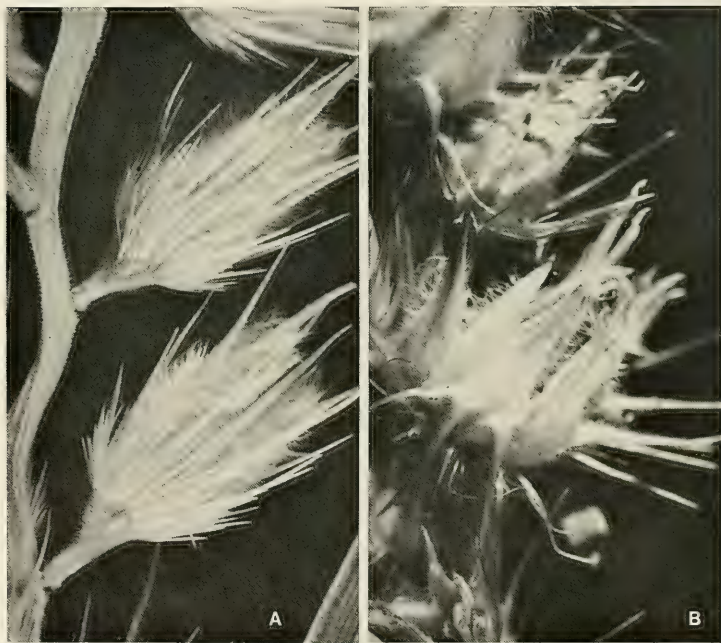


FIGURE 77. A, *Cenchrus calyculatus*, portion of raceme showing two burrs, $\times 8$, from *Smith* 7942; B, *Cenchrus echinatus*, burrs, $\times 8$, from *Smith* 9454.

2. *Cenchrus echinatus* L. Sp. Pl. 1050. 1753; C. H. Wright in Dept. Agr. Fiji Circ. 3: 41. 1922; Summerhayes & Hubbard in Kew Bull. 1927: 39. 1927, in op. cit. 1930: 261. 1930; B. E. V. Parham, Fijian Pl. Names, 54. 1942, in Agr. J. Dept. Agr. Fiji 20: 15. 1949; Greenwood in J. Arnold Arb. 25: 405. 1944; J. W. Parham in Dept. Agr. Fiji Bull. 30: 108. fig. 44. 1956, in op. cit. 35: 169. fig. 92. 1959, Pl. Fiji Isl. 301. 1964, ed. 2. 398. 1972. FIGURE 77B.

Annual, the culms compressed, generally geniculate, branching at base, 15–90 cm. high; leaf blades 7.5–22 cm. long, 5–10 mm. broad, pilose on upper surface near base; spikes 2.5–7.5 cm. long; burrs fairly large, 5–15 on each spike, not crowded, almost sessile, 5–10 mm. high, much broadened at base, usually with 4 spikelets in each burr.

TIPIFICATION: Linnaeus gave several prior references and then noted the locality as Jamaica and Curaçao.

DISTRIBUTION: A common weed in tropical America, now widespread in warm countries. It is of frequent occurrence in Fiji, more than 40 collections being at hand. It is usually restricted to low elevations near the coast, being found on seashores and in pastures, cane and rice fields, lawns, waste places, and along roadsides. Flowers and fruit are noted throughout the year.

LOCAL NAMES AND USE: *Se mbulambula*, *burr grass*. Far from having any economic use, *Cenchrus echinatus* is a serious pest because of the burrs, which can attach themselves to the coats of animals and to clothing.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Navondi, Nandi, DA 8985; Natawa, Tavua, DA 8174. NANDRONGA & NAVOSA: Singatoka sand dunes, DA 3624; Yanutha Island, DA 9029. SERUA: Ngalea, Smith 9454; Naitonitoni, Navua, DA 2843. RA: Near Penang, DA 7047; Waimare, DA 9538. TAILEVU: Nukumbuta, Namara, DA 1684. REWA: Suva, DA 3023. KANDAVU: Vunisea, DA 2991. VANUA LEVU: MATHUATA: Near Ndaku Village, Kia Island, DA 11773; Malau, DA 8809. THAKAUNDROVE: Nakama, Savusavu, DA 8850; Naingingi, DA 10781. TAVEUNI: Waiyevo, DA 8937. VANUA MBALAVU: Lomaloma, DA 10240. LAKEMBA: Near Tumbou, Garnock-Jones 881.

3. *Cenchrus ciliaris* L. Mant. Pl. Alt. 302. 1771; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 20: 15. 1949; J. W. Parham, Pl. Fiji Isl. 301. 1964, ed. 2. 398. 1972.

Pennisetum ciliare Link, Hort. Reg. Bot. Berol. 1: 213. 1827; J. W. Parham in Dept. Agr. Fiji Bull. 30: 106. 1956.

Perennial, tufted from base, the culms geniculate, 30–150 cm. high; leaf blades flat or folded, 15–30 cm. long, 5–10 mm. broad; spike 2–10 cm. long, flexuous, the fascicles spreading, deep blue-purple in color; bristles united at base, unequal, the outer ones short, scabrous, the inner ones thick, approximately twice length of spikelet, ciliate; spikelets 1–5 in each fascicle, 2.5–5 mm. long.

TIPIFICATION: The original material came from Africa.

DISTRIBUTION: Hot, dry parts of India, the Mediterranean region, tropical southern Africa, Australia, and America. It is a valuable pasture grass which has shown promise under trial conditions in Fiji, where it is also naturalized in one or two localities. Twenty-five or 30 Fijian collections are available. Flowers have been recorded throughout the year.

LOCAL NAME AND USE: *Buffel grass*. It may become a useful pasture grass locally.

REPRESENTATIVE COLLECTIONS: VITI LEVU: NANDRONGA & NAVOSA: Agricultural Station, Nathotholevu, Singatoka, DA 11844, 12579. NAITASIRE: Research Station, Koronivia, DA 3961, 7457; Plant Introduction and Quarantine Station, Nanduruloulou, DA 3583, 9040. VANUA LEVU: MATHUATA: District Farm Northern, Seanggangga, DA 15390. FIJI without further locality, FDA 14612, 15457 (numbers under which some of the trial introductions were recorded).

37. *Pennisetum* L. C. Rich. ex Pers. Syn. Pl. 1: 72. 1805.

Annuals or perennials, often branched; leaf blades flat; panicles spike-like, dense; spikelets solitary or in twos or threes, surrounded by an involucre of bristles, not joined together except at base, often plumose, falling attached to spikelets; lower glume shorter than, or equal to, sterile lemma, the fertile lemma chartaceous, smooth, with a thin margin, enclosing the palea.

LECTOTYPE SPECIES: *Pennisetum typhoideum* L. C. Rich., nom. illeg. (*Holcus spicatus* L.: *P. spicatum* (L.) Körnicke) (ING).

DISTRIBUTION: About 130 species in the warm regions of the world. Four species are known to occur in Fiji and one of these, *Pennisetum polystachyon*, is very common.

Two other species of *Pennisetum* were brought into introduction plots in Fiji, but they did not persist and are not naturalized (cf. J. W. Parham in Dept. Agr. Fiji Bull. 30: 105, 106. 1956). The *kikuyu* grass (*P. clandestinum* Hochst. ex Chiov.), a native of Africa, is a pasture grass not represented by any Fijian collections I have seen. The *kyasuwa* grass (*P. pedicellatum* Trin.) was introduced from Trinidad and is represented by DA 3231, 3951, and 12964; these were collected in trial plots, but the species is not otherwise represented in Fiji.

KEY TO SPECIES

Lemmas more or less alike, the lower one not 3-lobed; upper floret not deciduous; rachis ribbed but not obviously so, the ribs not winged; erect annuals or perennials with a well-developed inflorescence.

Spikelets solitary, sessile, spreading at right angles to rachis; bristles plumose, 10–18 mm. long; perennial. 1. *P. purpureum*

Spikelets 1–3, short-pedicellate; bristles purplish, not plumose, up to 30 mm. long; perennial. 2. *P. setaceum*

Spikelets crowded, gaping open and exposing grain; bristles plumose, not more than 7 mm. long; annual. 3. *P. americanum*

Lemmas not alike, the lower one often 3-lobed; upper floret readily disarticulating; rachis with decurrent wings on ribs below pedicels; annual, the culms much-branched; bristles densely plumose, especially the inner ones, 10–15 mm. long. 4. *P. polystachyon*

1. *Pennisetum purpureum* Schumacher, Beskr. Guin. Pl. 44. 1827; C. H. Wright in Dept. Agr. Fiji Circ. 3: 40. 1922; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 20: 19. 1949, in Proc. 7th Pacific Sci. Congr. 5: 237. fig. 3. 1953; J. W. Parham in Dept. Agr. Fiji Bull. 30: 102. fig. 42. pl. VII. 1956, Pl. Fiji Isl. 308. 1964, ed. 2. 408. 1972.

Perennial, robust, leafy, the culms 1.5–3 m. high; leaf blades 22–60 cm. long, 1.8–3 cm. broad; panicle elongate, dense, stiff, tawny-yellow in color, 15–30 cm. long; spikelets about 4 mm. long, the bristles sparsely plumose, 10–18 mm. long.

TYPIIFICATION: The species is based on material from Guinea, Africa.

DISTRIBUTION: A native of tropical Africa, now widespread in other tropical regions where it is often grown as a fodder grass. It was introduced into Fiji in the early 1920's but, despite its value as a fodder, it is not grown on a wide scale. It may not be truly naturalized yet but is likely to become so. Flowers have been noted in April and July.

LOCAL NAMES AND USE: *Elephant grass*, *Napier grass*. It has considerable potential as a fodder grass in Fiji.

AVAILABLE COLLECTIONS: VITI LEVU: NANDRONGA & NAVOSA: Agricultural Station, Nathotholevu, Singatoka, DA 8292. REWA: Domain road, Suva, DA 2063; Department of Agriculture grounds, Suva, DA 7960.

2. ***Pennisetum setaceum*** (Forssk.) Chiov. in Boll. Soc. Bot. Ital. **1923**: 113. 1923; B. E. V. Parham in Agr. J. Dept. Agr. Fiji **20**: 19. 1949; J. W. Parham, Pl. Fiji Isl. ed. 2. 408. 1972.

Phalaris setacea Forssk. Fl. Aegypt.-Arab. 17. 1775.

Pennisetum macrostachyum sensu Summerhayes & Hubbard in Kew Bull. **1930**: 261. 1930; J. W. Parham in Dept. Agr. Fiji Bull. **30**: 105. 1956, Pl. Fiji Isl. 308. 1964; non Trin.

Pennisetum ruppellii sensu B. E. V. Parham in Agr. J. Dept. Agr. Fiji **20**: 19. 1949, in Proc. 7th Pacific Sci. Congr. **5**: 237. 1953; J. W. Parham in Dept. Agr. Fiji Bull. **30**: 105. 1956, Pl. Fiji Isl. 308. 1964; non Steudel.

Perennial, the culms tufted, 2–4.5 m. high; leaf blades narrow, scabrous, 30–45 cm. long, 20–25 mm. broad, dark purple-red in color; panicle 15–30 cm. long, flexuous; spikelets 1–3, short-pedicellate, about 4 mm. long, surrounded by numerous bristles, these unequal in length, purple-pink in color, not plumose, up to 30 mm. long.

TIPIFICATION: The original material came from Arabia.

DISTRIBUTION: A native of Africa, now widespread as an ornamental because of its deep purple-red leaves and attractive panicles of purple-pink spikelets. It was probably introduced into Fiji in the 1920's and is now a commonly cultivated plant (in spite of the few specimens cited below), semi-naturalized in some places. Flowers have been noted in January.

LOCAL NAME AND USE: *Fountain grass*. It is a useful ornamental and hedge plant.

AVAILABLE COLLECTIONS: VITI LEVU: NAITASIRI: Tamavua, DA 16225. REWA: Botanical Gardens, Suva, DA 12303.

3. ***Pennisetum americanum*** (L.) K. Schum. in Engl. Pflanzenw. Ost-Afrikas **B**: 51. 1895.

Panicum americanum L. Sp. Pl. 56. 1753.

Alopecurus typhoides Burm. f. Fl. Ind. 27. 1768.

Pennisetum typhoides Stapf & Hubbard in Kew Bull. **1933**: 271. 1933; B. E. V. Parham in Agr. J. Dept. Agr. Fiji **20**: 19. 1949; J. W. Parham in Dept. Agr. Fiji Bull. **30**: 105. 1956, Pl. Fiji Isl. ed. 2. 409. 1972.

Pennisetum glaucum sensu J. W. Parham in Dept. Agr. Fiji Bull. **30**: 101. 1956; non R. Br.

Annual, the culms stout, 150–180 cm. high, densely villous below panicle; leaf blades flat, cordate, up to 90 cm. long and 5 cm. broad; panicle cylindrical, stiff, dense, 10–45 cm. long, pale bluish in color; spikelets short-stalked, 2 in each fascicle, obovate, 3.5–5 mm. long, the bristles plumose, not more than 7 mm. long; grain at maturity protruding from lemma and palea.

TIPIFICATION AND NOMENCLATURE: Linnaeus indicated that his original material came from America, giving three prior citations. For *Alopecurus typhoides*, Burman indicated two prior references to Indian plants.

DISTRIBUTION: Cultivated for the grain in India and tropical Africa and introduced into Fiji for trial. It is not common but has occasionally been noted under cultivation and as an escape. Flowers have been observed in April, October, and December.

LOCAL NAMES AND USE: *Pearl millet*, *bajra* (Hindi). The species produces an edible grain and is extensively cultivated in India; up to the present its use in Fiji is very limited.

AVAILABLE COLLECTIONS: VITI LEVU: NAITASIRI: Korongganga, DA 5621; Plant Introduction and Quarantine Station, Nanduruloulou, DA 3600, 3601, 3602, 3603, 3604, 3618, 3623. REWA: King's Wharf, Suva, DA 3170.

4. ***Pennisetum polystachyon*** (L.) J. A. & J. H. Schultes, Mant. Syst. Veg. **2**: 146. 1824; Summerhayes & Hubbard in Kew Bull. **1930**: 260. 1930; Greenwood in

J. Arnold Arb. **25**: 404. 1944; B.E.V. Parham in Agr. J. Dept. Agr. Fiji **20**: 19. 1949, in Proc. 7th Pacific Sci. Congr. **5**: 231, 237. 1953; J.W. Parham in Dept. Agr. Fiji Bull. **30**: 103. fig. 43. 1956, in op. cit **35**: 169. fig. 91. 1959, Pl. Fiji Isl. 308. 1964, ed. 2. 408. 1972.

Panicum polystachyon L. Syst. Nat. ed. 10. 870, as *P. polystachion*. 1759.

Perennial, tufted, the culms slender to fairly stout, up to 3 m. high, often branched; leaf blades narrow, 5–45 cm. long, 5–18 mm. broad; spike yellow-brown, 5–25 cm. long; spikelets alike, about 4 mm. long, 2-flowered, only the upper one perfect, surrounded by numerous bristles and falling with the spikelet attached, the bristles unequal, densely plumose, 10–15 mm. long.

TIPIFICATION: The original material came from India.

DISTRIBUTION: Tropical parts of the Old World. It was introduced into Fiji from Gainesville, U.S.A., in 1920 and distributed as a fodder plant. It is now naturalized from sea level to about 1,000 m. on open hillsides, in rocky stream beds, and along roadsides. It grows in very dense stands and is the dominant plant on open hills in certain areas miles in extent, especially in the dry zones of Viti Levu but also in parts of Vanua Levu. It is now common in Mbua Province, Vanua Levu, and is spreading rapidly into Mathuata Province; it is also well established on the Natewa Peninsula, Thakaundrove Province. This *Pennisetum* has become one of the most common grasses in Fiji, and certainly the most successful of the introduced species. I have seen about 50 Fijian specimens; it flowers in most months and produces enormous quantities of seed.

LOCAL NAME AND USE: *Mission grass*. It has some value as a fodder when young but generally is considered a weed which, because of its habit of growth in clumps, does not help greatly to prevent soil erosion during the wet season.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Lautoka, *DA 8213*; near Nandi airport, *DA 8254*; vicinity of Nalotawa, eastern base of Mt. Evans Range, *Smith 4263*; slopes of escarpment north of Nandarivatu, *Smith 6282*. NANDRONGA & NAVOSA: Keiasi, upper Singatoka River Valley, *DA 10181*. SERUA: Navua, *DA 8998*. RA: Matawailevu, *DA 7887*; near Vaileka, *DA 8139*. NAITASIRI: Vicinity of Nasinu, *Gillespie 3671*; Research Station, Koronivia, *DA 6083*; Plant Introduction and Quarantine Station, Nanduruloulou, *DA 3575*. TAILEVU: Waimaro, *DA 7691*. VANUA LEVU: MBUA: Nanggere, near Mbua Village, *DA 16687*. THAKAUNDRIVE: Near Mbutha, Mbutha Bay, *DA 16877*.

38. *SACCIOLEPIS* Nash in Britton, Man. Fl. N. U. S. 89. 1901.

Annuals or perennials, usually branching; panicle spike-like, dense and elongate; spikelets oblong, the lower glume shorter than spikelet, the upper glume broad, many-nerved, the sterile lemma narrow, flat, with palea about same length, often subtending a ♂ flower, the fertile lemma elliptic, with inrolled margins, the palea not enclosed at apex.

TYPE SPECIES: *Sacciolepis gibba* (S. Elliott) Nash (*Panicum gibbum* S. Elliott) (ING).

DISTRIBUTION: Tropical and subtropical areas, with about 30 species. Only one species, *Sacciolepis indica*, occurs in Fiji; it is common throughout the group, which suggests that it was an early introduction.

1. *Sacciolepis indica* (L.) Chase in Proc. Biol. Soc. Wash. **21**: 8. 1908; Summerhayes & Hubbard in Kew Bull. **1930**: 259. 1930; Greenwood in J. Arnold Arb. **25**: 404. 1944; J.W. Parham in Dept. Agr. Fiji Bull. **30**: 61. fig. 23. 1956, in op. cit. **35**: 156. 1959, Pl. Fiji Isl. 309. 1964, ed. 2. 409. 1972.

Aira indicum L. Sp. Pl. (Errata, 63, no. 1). 1753.

Aira spicata L. Sp. Pl. 63. 1753; non 64, no. 7.

Annual, the culms slender, simple or branched, up to 1.5 m. high; leaf blades narrow, 2.5–15 cm. long, 3–6 mm. broad; panicle spike-like, cylindrical, dense, 1.2–7.5 cm. long, the branches about 3 mm. long; spikelets alike, obliquely ovate, 2.5–3 mm. long, 2-flowered, the upper glume strongly nerved, with ciliate margins, the lemmas strongly nerved, only the upper floret perfect, falling entire.

TYPIFICATION: Linnaeus based his species on material from India.

DISTRIBUTION: Tropical Asia, Australia, and into Polynesia; introduced into Africa and America. It is moderately common in Fiji from sea level to about 1,000 m. on open hillsides, sand and gravel banks in stream beds, in weedy thickets along roadsides and trails, and as a weed of cultivation and waste places. Approximately 50 Fijian collections are available. Flowers have been noted from February through October. No local names or uses have been noted.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Mt. Nanggaranambuluta, near Nandarivatu, *DA 10374*. NANDRONGA & NAVOSA: Northern portion of Rairaimatuku Plateau, between Nandrau and Reswasau, *Smith 5645*. SERUA: Ndeumba, *DA 8636*; Tokotoko road, Navua, *DA 8660*. NAMOSI: Valley of Wainambua Creek, south of Mt. Naitarandamu, *Smith 8768*; Wainilotulevu, *DA 9099*. NAITASIRI: Vinindawa, *DA 7797*; Wainimbuku, Nasinu, *DA 8697*; Nanduna, *DA 9608*. TAILEVU: East of Wainimbuka River, near Ndakuivuna, *Smith 7009*; Verata road, *DA 8475*. REWA: Mt. Korombamba, *DA 1172*; Lokia, *DA 8602*. VANUA LEVU: MBUA: *DA 5024*.

39. *ANCISTRACHNE* S. T. Blake in Univ. Queensland Dept. Biol. Pap. 1 (19): 4. 1941.

Perennial, the culms woody, bamboo-like; leaf blades narrowed into a minute petiole; panicle open; spikelets subglobose, placed obliquely on pedicels, the lower glume one-third length of spikelet, the upper glume and sterile lemma approximately equal, the lemma enclosing membranaceous palea and sometimes a ♂ flower; fertile lemma white, bony, indurate, obovate.

TYPE SPECIES: *Ancistrachne uncinulata* (R. Br.) S. T. Blake (*Panicum uncinulatum* R. Br.) (ING).

DISTRIBUTION: Three species, recorded from Australia, the Philippine Islands, and Fiji. The present is the first published record of the occurrence of the genus in Fiji.

1. *Ancistrachne uncinulata* (R. Br.) S. T. Blake in Univ. Queensland Dept. Biol. Pap. 1 (19): 5. 1941.

FIGURE 78A & B.

Panicum uncinulatum R. Br. Prodr. Fl. Nov. Holl. 191. 1810.

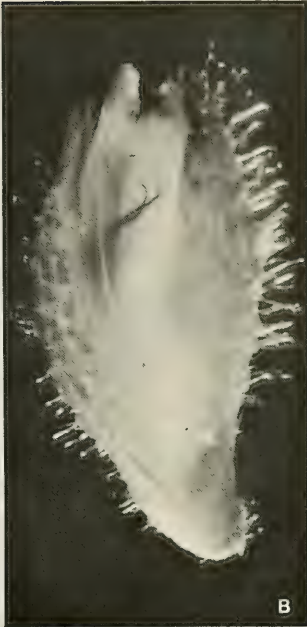
Perennial, the culms woody, terete, ribbed, dichotomously branched, glabrous, glaucous-green, up to 1 m. high; leaf blades ascending, linear-lanceolate, 4–9 cm. long, 2–4 mm. broad, the apex ending in a fine mucronate point, the petiole about 0.5 mm. long, brown in color; panicle terminal, 4–15 cm. long, about 5 cm. broad, with distantly placed, alternate, ascending branches 4–6 cm. long; spikelets solitary, in pairs, on pedicels 1–3 mm. long, falling entire, 3–4.5 mm. long; grain elliptic to ovoid when mature.

TYPIFICATION: Brown's original material came from Australia.

DISTRIBUTION: Australia, the Philippine Islands, and Fiji; its occurrence in Fiji was first evidenced by a collection made on February 6, 1969, by O. and I. Degener; there is no reason to suppose that the introduction of the species into Fiji was intentional, but the distribution, if natural, is very unusual. A second collection has since been made from a different part of the archipelago. Flowers have been noted in February and July.

LOCAL NAME: *Mbitu ni vakatani ramathake*.

AVAILABLE COLLECTIONS: MAMANUTHA GROUP: NGGALITO Island, west of Malolo Island, O. & I. Degener 32251 (in open forest at about 240 m., forming small clumps with erect to spreading diaphanous culms). MAKONDRONGA (north of Makongai, Loma-i-Viti): *DA 17386*.



40. *Rhynchelytrum* Nees in Lindl. Nat. Syst. Bot. ed. 2. 446, as *Rhynchelythrum*, sphalm. 1836.

Annuals or perennials, the culms slender, branching, decumbent; panicle soft or silky, giving off fine branchlets or racemes, the ultimate branches often with long, fine hairs; spikelets small, surrounded by silky hairs.

TYPE SPECIES: *Rhynchelytrum dregeanum* Nees (ING). However, C.E. Hubbard, as indicated below, considers this a taxonomic synonym of *Saccharum repens* Willd.: *Rhynchelytrum repens* (Willd.) Hubbard.

DISTRIBUTION: Africa, Madagascar, and Arabia to southeastern Asia, with about 37 species, of which only one is naturalized in Fiji.

1. *Rhynchelytrum repens* (Willd.) Hubbard in Kew Bull. 1934: 110. 1934; B.E.V. Parham, Fijian Pl. Names, 54. 1942, in Proc. 7th Pacific Sci. Congr. 5: 233. 1953; J.W. Parham in Dept. Agr. Fiji Bull. 30: 99. fig. 41. 1956, in op. cit. 35: 167. 1959, Pl. Fiji Isl. 309. 1964, ed. 2. 409. 1972.

Saccharum repens Willd. Sp. Pl. 1: 322. 1798.

Tricholaena rosea Nees, Ind. Sem. Hort. Vratisl. 1835; B.E.V. Parham in Proc. 7th Pacific Sci. Congr. 5: 233. 1953.

Rhynchelytrum dregeanum Nees in Lindl. Nat. Syst. Bot. ed. 2. 447. 1836; Summerhayes & Hubbard in Kew Bull. 1927: 38. 1927; B.E.V. Parham in Agr. J. Dept. Agr. Fiji 20: 19. 1949.

Rhynchelytrum roseum Stapf & Hubbard ex Bews, The World of Grasses, 223. 1929, in Prain, Fl. Trop. Afr. 9: 880. 1930; Summerhayes & Hubbard in Kew Bull. 1930: 260. 1930; Greenwood in J. Arnold Arb. 25: 404. 1944.

Annual, the culms slender, 35–90 cm. high; leaf blades flat, markedly nerved, 5–15 cm. long, 2.5–5 mm. broad; panicle soft pink to mauve-colored, 7.5–15 cm. long, with slender, ascending branches 2–4 cm. long; spikelets finely nerved, silky-pilose, 2.5–3 mm. long, the lower glume truncate or emarginate, the upper glume same length as spikelet, mucronate or with short awn up to 4 mm. long, the spikelets surrounded by soft, pink-colored hairs 5–7.5 mm. long.

TYPIIFICATION AND NOMENCLATURE: The types of the three species concerned in this synonymy were all obtained in Africa.

DISTRIBUTION: Tropical and southern Africa, but now widely distributed in other warm countries. *Rhynchelytrum repens* was apparently first introduced into Fiji by Thurston in the 1880's, probably as an ornamental, and it is now common from sea level to about 600 m. along roadsides and in cultivated areas, on hillsides, and along forested streams in reed country. Twenty-five or 30 Fijian collections are at hand. Flowers have been noted from February through October.

LOCAL NAMES AND USE: *Natal red top*, *Holme's grass*, *thongithongi*. Although a grass of ornamental potential, it is more often regarded as a weed of cultivation in Fiji.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Vakambuli, near Lautoka, DA 8235; near Nandi airport, DA 8247; Sambeto Valley, DA 8269; vicinity of Nalotawa, eastern base of Mt. Evans Range, Smith 4259. NANDRONGA & NAVOSA: Near Momi lighthouse, DA 8285; upper Singatoka Valley, DA 7972. RA: Rakiraki, DA 7930; Vaileka, DA 8107. REWA: Near hospital, Suva, DA 1648; Cakobau road, Suva, DA 7480. VANUA LEVU: MATHUATA: Nasonisoni, Lambasa, DA 3669; Molau, DA 8810; Waingili, DA 8743.

FIGURE 78. A & B, *Ancistrachne uncinulata*, from O. & I. Degener 32251; A, portion of inflorescence, × 4; B, floret, × 25. C, *Isachne vitiensis*, tip of lateral branch of inflorescence, × 4, from Smith 1660. D & E, *Isachne globosa*, from DA 7597; D, basal portion of inflorescence, × 4; E, apical portion of inflorescence, × 4.

41. *ISACHNE* R. Br. Prodr. Fl. Nov. Holl. 196. 1810.

Mostly perennials; leaf blades stiff, sometimes with a distinct petiole, often scabrous; panicle open or contracted; spikelets obovoid or subglobose, the glumes membranaceous, about equal, the lower floret either perfect or ♂ with lemma and palea both indurate, similar to upper floret.

TYPE SPECIES: *Isachne australis* R. Br. (ING).

DISTRIBUTION: Tropical and subtropical areas, with about 60 species. Two species occur in Fiji, one endemic and the other sparsely naturalized.

KEY TO SPECIES

Leaf blades 5–20 cm. long, glabrous on upper surface; panicle more or less open, up to 25 cm. long, the axis short-hairy; spikelets yellow, about 1 mm. long 1. *I. vitiensis*
 Leaf blades 5–10 cm. long, villous on upper surface; panicle compact, up to 7.5 cm. long, the racemes with dark "bands" at intervals; spikelets purple-tinged, 1.5–2 mm. long. 2. *I. globosa*

1. *Isachne vitiensis* Rendle in J. Linn. Soc. Bot. 39: 181. 1909; Summerhayes & Hubbard in Kew Bull. 1927: 40. 1927, in op. cit. 1930: 261. 1930; J. W. Parham in Dept. Agr. Fiji Bull. 30: 53. fig. 19. 1956, Pl. Fiji Isl. 306. 1964, ed. 2. 404. 1972.

FIGURE 78C.

Perennial, the culms 30–90 cm. high; leaf blades stiff, scabrous, with conspicuous nerves and thickened margins; panicle up to 25 cm. long, the branches 0.5–7 cm. long, ascending; spikelets ovoid, borne on very short pedicels, the glumes glabrous, the lemma margins ciliate.

TIPIFICATION: The type is *Gibbs 815* (BM), collected at Tholo-i-Nandarivatu (apparently a hill in the vicinity of Nandarivatu, although none is now known by that name), Mba Province, Viti Levu, at an altitude of about 945 m., in September, 1907.

DISTRIBUTION: Endemic to Fiji and reasonably common at elevations of about 150–1,300 m. (very rarely at sea level), in dry thickets, crest thickets, open forests, in shady places and on wet rocks in forest; it is often very common along forest trails. Thirty to 40 collections are known, and it has been noted in flower during most months.

LOCAL NAME: *Tho mbitu mbitu* (noted in Tailevu Province).

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Mt. Evans Range, *Greenwood 326*; Korolevaleva Ridge, *DA 1456*; vicinity of Nandarivatu, *Degener 14750*; Mt. Tomanivi Lailai, *DA 7087*. NAMOSI: Hills north of Wainavindrau Creek, between Korombasambasanga Range and Mt. Naitarandamu, *Smith 8478*; Korombasambasanga Range, *DA 2237*; Mt. Voma, *DA 11665*. NAITASIRI: Mendrausuthu Range, summit of highest peak, *DA 15470*; Tholo-i-suva, *DA 9848*. TAILEVU: East of Wainimbuka River, near Ndukui-vuna, *Smith 7055*. REWA: Mt. Korombamba, *DA 1144, 16544*. OVALAU: Summit of Mt. Ndelaiovalau and adjacent ridge, *Smith 7574*. VANUA LEVU: MBUA: Navotuvotu, summit of Mt. Seatura, *Smith 1660*. THAKAUNDROVE-MATHUATA boundary: Korotini Range between Navitho Pass and Mt. Ndelaikoro, *Smith 545*. TAVEUNI: Track from Somosomo to Crater Lake, *DA 14385*; west of old crater above Somosomo, *Smith 8357*. YATHATA: Navukathuru (near sea level), *DA 16199*.

2. *Isachne globosa* (Thunb.) Kuntze, Rev. Gen. Pl. 2: 778. 1891; J. W. Parham in Dept. Agr. Fiji Bull. 30: 53. 1956, Pl. Fiji Isl. 306. 1964, ed. 2. 404. 1972.

FIGURE 78D & E.

Milium globosum Thunb. Fl. Jap. 49. 1784.

Isachne dispar sensu Greenwood in J. Arnold Arb. 30: 84. 1949; Swallen in op. cit. 31: 142. 1950; J. W. Parham, Pl. Fiji Isl. 206. 1964, ed. 2. 404. 1972; non Trin.

Semiprostrate, with erect flowering culms 15–90 cm. high; sheaths fairly loose, the leaf blades tapering to a rounded apex, the margins scabrous; panicle compact,

6–8 cm. long, the racemes 6–18 mm. long; spikelets rounded, the glumes ciliate along margins and nerves.

TYPEFICTION: Thunberg based his species on material from Japan.

DISTRIBUTION: Eastern Asia. It was presumably an accidental introduction into Fiji, noted at only two localities at very diverse elevations, 800 m. and sea level respectively. At the higher elevation the species was found in open, sunny, swampy ground near a creek. Flowers were noted in March and May.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Nandarivatu, *Greenwood 1178*. REWA: Suva Point, *DA 7597*.

42. *IMPERATA* Cirillo, Pl. Rar. Neapol. 2: 26. 1792; Seem. Fl. Vit. 322. 1868.

Perennials, the culms slender, erect, rising from hard, scaly rhizomes; panicles terminal, narrow and silky; spikelets alike, lacking awns, in pairs, unequally stalked on slender, continuous rachis surrounded by long, silky hairs, the glumes approximately equal, membranaceous; sterile and fertile lemmas and palea thin, hyaline.

TYPE SPECIES: *Imperata arundinacea* Cirillo, nom. illeg. (*Lagurus cylindricus* L.: *I. cylindrica* (L.) Beauv.) (ING).

DISTRIBUTION: About ten tropical and subtropical species are usually recognized. Only one species, *Imperata conferta*, is known from Fiji.

1. *Imperata conferta* (Presl) Ohwi in Bot. Mag. (Tokyo) 55: 549. 1941; J.W. Parham, Pl. Fiji Isl. 306. 1964, ed. 2. 404. 1972; J. Daniels in Proc. 12th I. S. S. C. T. Congr. 1011. 1967; S. Price & J. Daniels in J. Heredity 59: 144. 1968.

Saccharum confertum Presl, Rel. Haenk. 1: 346. 1830.

Imperata arundinacea sensu Seem. Fl. Vit. 322. 1868; non Cirillo.

Imperata cylindrica var. *koenigii* sensu Summerhayes & Hubbard in Kew Bull. 1927: 26. 1927; non Durand & Schinz.

Imperata exaltata sensu Summerhayes & Hubbard in Kew Bull. 1930: 253. 1930; Greenwood in Proc. Linn. Soc. 154: 105. 1943; B.E.V. Parham in Proc. 7th Pacific Sci. Congr. 5: 233. 1953; J.W. Parham in Dept. Agr. Fiji Bull. 30: 109. 1956; non Brongn.

Imperata cylindrica sensu B.E.V. Parham, Fijian Pl. Names, 54. 1942, in Agr. J. Dept. Agr. Fiji 20: 17. 1949; J.W. Parham in Dept. Agr. Fiji Bull. 30: 109. fig. 45. 1956, in op. cit. 35: 169. fig. 93. 1959; non Beauv.

Perennial, tufted, the culms 45–90 cm. high; leaf blades 15–30 cm. long, 2.5–6 mm. broad, with narrow bases; panicle spike-like, silky, cylindrical, 5–20 cm. long, the branches 1–6 cm. long; spikelets paired, unequally stalked, all alike, 2.5–3 mm. long, falling entire at maturity, surrounded from base by long silky hairs up to 10 mm. long.

TYPEFICTION AND NOMENCLATURE: Presl's concept was based on material from the Philippine Islands. Various other names used in the Fijian literature appear to have been misidentifications.

DISTRIBUTION: Southeastern Asia and Malesia. This grass is common in Fiji from sea level to about 900 m., occurring on hillsides, along streams and trails in dense or open forest, on damp slopes, along roadsides, and on coconut plantations. It is not easy to eradicate but is nowhere found covering large areas. About 50 Fijian collections are available. Flowers have been noted throughout the year.

LOCAL NAMES AND USE: *Ngi*, *plume grass*. Although *Imperata conferta* is attractive when in flower, it is not considered an ornamental at least in Fiji, where, on the contrary, it is a weed of cultivation difficult to eradicate.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Old Reservoir road, Mba, *DA 11335*; Nandarivatu, *Degener & Ordóñez 13572*, *DA 2093*. NADRONGA & NAVOSA: Yanutha Island, *DA 9030*. SERUA: Between Ngaloa and Korovou, *Smith 9485*; Ndeumba, *DA 8624*. NAMOSI: Valley of Wainambua Creek,

south of Mt. Naitarandamu, *Smith 8769*. RA: District Farm, Ndombuilevu, *DA 7308*. NAITASIRI: Between Suva and Nasinu, *Gillespie 3163.5*; Research Station, Koronivia, *DA 3981*; Mbatiki, Nandurulou-lou, *DA 1206*. TAILEVU: Navuloa, *DA 9328*. REWA: Suva, *C. R. Turbet 33*. KANDAVU: Tavuki, *DA 9080*. VANUA LEVU: MATHUATA: Tambia, *DA 8762*; near Ndaku, *DA 8787*. THAKAUNDROVE: Savusavu, *DA 8868*; Maravu, near Salt Lake, *Degener & Ordenez 14204*; near Mbutha, Mbutha Bay, *DA 16875*. VANUA LEVU without further locality, *U. S. Expl. Exped. TAVEUNI*: Vicinity of Waiyevo, *Gillespie 4714*; Wairiki, *DA 8911*. Further records were noted by Summerhayes and Hubbard for the islands of Ovalau, Moturiki, Wakaya, Koro, Ngau, Moala, Matuku, and Lakemba.

43. *MISCANTHUS* Anderss. in Oefvers. Förh. Kongl. Svenska Vetensk.-Akad. 12: 165. 1855.

Eulalia sensu Seem. Fl. Vit. 321. 1868; non Kunth.

Perennials; leaf blades elongate, flat; panicles terminal, made up of a large number of slender, spreading racemes; spikelets alike, unequally stalked, membranaceous, sometimes slightly coriaceous, the sterile lemma hyaline, slightly shorter than glumes, the fertile lemma hyaline, extending into a slender, bent, flexuous awn, the palea small, hyaline.

LECTOTYPE SPECIES: *Miscanthus capensis* (Nees) Anderss. (*Erianthus capensis* Nees) (ING).

DISTRIBUTION: Southern Africa to Japan and the Philippine Islands, now extending well into the Pacific; about 20 species are generally recognized. One species is very common throughout Fiji and is widely utilized.

1. *Miscanthus floridulus* (Labill.) Warb. ex K. Schum. & Lauterb. Fl. Deutsch. Schutzgeb. Südsee, 166. 1901; J. W. Parham, Pl. Fiji Isl. 307. 1964, ed. 2. 406. 1972; J. Daniels in Proc. 12th I. S. S. C. T. Congr. 1010. 1967; S. Price & J. Daniels in J. Heredity 59: 144. 1968.

Saccharum floridulum Labill. Sert. Austro-Caled. 13. pl. 18. 1824; Seem. in Bonplandia 9: 261, as *S. floridum*. 1861, Viti, 444, as *S. floridum*. 1862.

Eulalia japonica sensu Seem. Fl. Vit. 321. 1868; non Trin.

Miscanthus japonicus sensu Summerhayes & Hubbard in Kew Bull. 1927: 26. 1927, in op. cit. 1930: 254. 1930; B. E. V. Parham, Fijian Pl. Names, 54. 1942, in Agr. J. Dept. Agr. Fiji 20: 18. 1949, in Proc. 7th Pacific Sci. Congr. 5: 230, 235. 1953; J. W. Parham in Dept. Agr. Fiji Bull. 30: 110. fig. 46. 1956, in op. cit. 35: 170. 1959; non Anderss.

Perennial, the culms 1.8–3.6 m. high, robust; leaf blades narrow, glabrous, 45–90 cm. long, 2–3.5 cm. broad, scabrous at margins; panicle oblong to oval, 20–45 cm. long, the branches slender, numerous, 7–30 cm. long; spikelets alike, paired, unequally stalked, falling entire at maturity, about 3 mm. long, 2-flowered, the upper floret perfect, surrounded from base by long silky hairs about 5 mm. long.

TIPIFICATION AND NOMENCLATURE: The type material of *Saccharum floridulum* is said to have come from Pagan Island, Marianna Islands. The species in much Pacific literature has often been referred to *Miscanthus japonicus*, which appears to be a misidentification at least as far as the species in the vicinity of Fiji is concerned.

DISTRIBUTION: A very common grass in many Pacific areas; in Fiji it is abundant (to such an extent that collectors often ignore it) from near sea level to about 900 m., often dominant on open slopes and forming dense thickets. The area covered by this grass is gradually diminishing, due to burning and its inability to compete with introduced species, especially *Pennisetum polystachyon* and, to a lesser extent, *Sporobolus indicus*. It mostly flowers between January and July.

LOCAL NAMES AND USES: *Ngasau*, native reed, *nasina* (noted in Serua only). It is an important component of Fijian economy, in many areas the leaves being the principal ingredient of thatching for house roofs and sometimes walls; the reeds are widely used for fish fences and garden stakes.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Vicinity of Nandarivatu, *Degener 14936*, SERUA: Mbuyo-mbuyo, near Namboutini, *Tabualewa 15588*, RA: Vaileka, *DA 8110*, NAITASIRI: Tholo-i-suva, near Forestry Station, *DA 16300*; Tamavua, opposite Medical School, *DA 7535, 7594*; King's Road, *DA 7467*. REWA: Suva, *Wilder 1231, Meebold 21942*; Suva Bay, *Bryan 190*; Ndelainivesi, *DA 9091*. MOALA: Near Naro'i, *Smith 1313*. TOTOTYA: *Bryan 353*. VANUA MBALAVU: Near Lomaloma, *Garnock-Jones 996*, LAKEMBA: Near Tumbou Jetty, *Garnock-Jones 755*. FIJI without further locality, *Gillespie 4672*; "Taveuni, Viti Levu, and Vanua Levu," *Seemann 691*.

44. *ERIANTHUS* Michx. Fl. Bor. Amer. 1: 54. 1803.

× *Miscanthosaccharum* Grassl in Proc. 12th I. S. S. C. T. Congr. 996, nom. provis. 1967.

Perennials, the culms reedlike; leaf blades elongate, flat; panicle terminal, oblong, silky; spikelets alike, paired, borne on a slender rachis, one sessile, one stalked, the rachis disarticulating below spikelets, the rachis joint and stalk falling attached to sessile spikelet; glumes equal, coriaceous, covered with long silky hairs especially near base, the sterile lemma hyaline with midnerve extended to a sterile awn, the palea small, hyaline.

LECTOTYPE SPECIES: *Erianthus saccharoides* Michx., nom. illeg. (*Anthoxanthum giganteum* Walter: *E. giganteus* (Walter) Muhlenberg) (ING).

DISTRIBUTION: As usually interpreted, *Erianthus* is composed of about 28 species in tropical America, southeastern Europe to eastern Asia, northern Africa, Madagascar, Indo-Malesia, and into the Pacific. One species, *E. maximus*, is moderately common in Fiji. The true taxonomic position of this grass is uncertain, as there is considerable evidence that it may be a hybrid between *Miscanthus floridulus* and *Saccharum officinarum*. In Grassl's interesting paper on this subject it would appear that his provisional generic name is intended to refer only to the species *E. maximus* and not to the entire genus; he mentions "a new so-called 'generic' name such as × *Miscanthosaccharum maximum*," but of course a generic name may not be in the form of a binomial. Pending further work on this problem, it is deemed prudent to continue to place *E. maximus* in Michaux's genus.

1. *Erianthus maximus* Brongn. in Duperrey, Voy. Coquille Bot.-Phan. 97. 1831; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 20: 17. 1949; J. W. Parham in Dept. Agr. Fiji Bull. 30: 114. 1956, Pl. Fiji Isl. 305. 1964, ed. 2. 402. 1972; J. Daniels in Proc. 12th I. S. S. C. T. Congr. 1008. 1967; S. Price & J. Daniels in J. Heredity 59: 143. 1968.

Erianthus floridulus sensu B. E. V. Parham, Fijian Pl. Names, 54. 1942, in Proc. 7th Pacific Sci. Congr. 5: 228. 1953; non Schultes.

Saccharum floridulum sensu H. B. R. Parham in Polynesian Soc. Mem. 16: 110. 1943; non Labill.

Miscanthus floridulus × *Saccharum officinarum* Grassl in Proc. 12th I. S. S. C. T. Congr. 996. 1967.

× *Miscanthosaccharum maximum* Grassl in Proc. 12th I. S. S. C. T. Congr. 996, nom. provis. 1967.

Perennial, the culms tall, robust, 3–3.6 m. or more high; leaf blades 60 cm. or more long, about 2.5 cm. broad; panicle 30–40 cm. long, with branches 10–25 cm. long, the internodes of rachis longer than spikelets; spikelets paired, one sessile, one stalked, the involucre hairs 8–10 mm. long.

TIPIFICATION: The original material described by Brongniart came from Tahiti, Society Islands.

DISTRIBUTION: Malesia to Solomon Islands, Fiji, and eastward in the Pacific. In Fiji it is moderately common in damp places from near sea level to about 600 m., in the wet zones of Viti Levu and Vanua Levu. Flowers have been noted in May and June.

LOCAL NAME: *Vitho*.

AVAILABLE COLLECTIONS: VITI LEVU: NAITASIRI: Nawanggambena, DA 252, 253, 255, 256, 258; Nanduna, DA 1580, 1581; King's Road, DA 1654. TAILEVU: Naimasimasi, DA 1655; between Mburetu and Ndaku, DA 887; hills east of Wainimbuka River, in vicinity of Wailotua, Smith 7254.

Grassl, Price, and Daniels, in the references listed above, agree with sugarcane workers that it is incorrect to classify the Fijian *vitho* and similar South Sea clones in the genus *Erianthus*. Chromosome numbers in the *vitho* clones lend support to Grassl's ideas that the *vithos* are somewhat like a hybrid swarm, with *Miscanthus floridulus* as one of the ancestral species. In the present work I merely call attention to the complex problems involved while for convenience retaining the nomenclature used in most current grass literature.

45. *Polytrias* Hackel in Engl. & Prantl, Nat. Pflanzenfam. II. 2: 24. 1887.

Perennial; racemes made up of pairs of sessile spikelets, each pair accompanied by a third, stalked spikelet.

TYPE SPECIES: *Polytrias praemorsa* (Nees) Hackel (*Pollinia praemorsa* Nees) (ING).

DISTRIBUTION: A monotypic genus occurring in Burma, Malaya, southeastern Asia, and China. It was first recorded from Fiji in 1956.

1. *Polytrias amaura* (Buese) Kuntze, Rev. Gen. Pl. 2: 788. 1891; J. W. Parham, Pl. Fiji Isl. 309. 1964, ed. 2. 409. 1972.

Andropogon amaurus Buese in Miq. Pl. Junghuhn. 360. Aug., 1854.

Pollinia praemorsa Nees ex Steudel, Syn. Pl. Glum. 1: 409. Nov., 1854.

Polytrias praemorsa Hackel in Engl. & Prantl, Nat. Pflanzenfam. II. 2: 24. 1887; J. W. Parham in Dept. Agr. Fiji Bull. 30: 112. fig. 47. 1956.

Perennial, the culms erect, branching from base, 2.5–25 cm. high; leaf blades pubescent, short, tapering, 1.2–5 cm. long, 1.5–3 mm. broad; racemes 1.2–2.5 cm. long; spikelets densely hairy, 3–4 mm. long, awned, brown to cream-colored, the awns red-brown, 6–8 mm. long.

TIPIFICATION AND NOMENCLATURE: The original material of both taxa concerned in the synonymy was obtained in Java.

DISTRIBUTION: Southeastern Asia; in Fiji first recorded from the vicinity of Natewa Bay and from roadsides and plantations in the Savusavu area, Vanua Levu. It is becoming moderately common from sea level to about 30 m. Flowers have been noted in July, August, and November.

LOCAL NAME AND USE: *Natewa blue grass* (from the circumstance of its first collection in Fiji from the Natewa Bay area by B. E. V. Parham). It is reported to be a useful lawn grass.

AVAILABLE COLLECTIONS: VITI LEVU: NANDRONGA & NAVOSA: Agricultural Station, Nathotholevu, Singatoka, DA 9784. NAITASIRI: Plant Introduction and Quarantine Station, Nanduruloulou (plants brought from Natewa Bay), DA 8323, 8469. VANUA LEVU: THAKAUNDROVE: Maravu Estate, DA 11905; Oneva Estate, DA 11906. FIJI without further locality, DA 3893.

46. *Saccharum* L. Sp. Pl. 54. 1753, Gen. Pl. ed. 5. 28. 1754; Seem. Fl. Vit. 321. 1868.

Perennials; spikelets in pairs, both perfect, one sessile, the other stalked, arranged in a panicle consisting of numerous racemes, the axis disarticulating below spikelets, the sterile lemma hyaline, the fertile lemma hyaline but sometimes absent.

LECTOTYPE SPECIES: *Saccharum officinarum* L. (ING).

DISTRIBUTION: *Saccharum* is usually considered to be composed of about five species of tropical and subtropical areas. Two species are recorded from Fiji; one of

these, *S. officinarum*, is commercially cultivated on a large scale and is the country's most important export crop.

USEFUL TREATMENTS OF GENUS: Grassl, C. O. *Saccharum robustum* and other wild relatives of "Noble" sugarcanes. *J. Arnold Arb.* 27: 234-252. 1946. Introgression between *Saccharum* and *Miscanthus* in New Guinea and the Pacific area. *Proc. 12th I. S. S. C. T. Congr.* 995-1003. 1967. Daniels, J. Sugar canes and related plants of the Fiji Islands. *op. cit.* 1004-1013. 1967. Price, S., & J. Daniels. Cytology of South Pacific sugarcane and related grasses. *J. Heredity* 59: 141-145. 1968.

KEY TO SPECIES

Culms 3.7-5 cm. in diameter, the lower nodes conspicuous; panicle plumose, large. . . . 1. *S. officinarum*
Culms 2.5-3.7 cm. in diameter, the nodes obscured by leaf sheaths; panicle enclosed in a sheath, not opening at all. . . . 2. *S. edule*

1. *Saccharum officinarum* L. Sp. Pl. 54, as *S. officinarum*. 1753; Seem. Fl. Vit. 321. 1868; Summerhayes & Hubbard in *Kew Bull.* 1927: 26. 1927; B. E. V. Parham, *Fijian Pl. Names*, 54. 1942, in *Agr. J. Dept. Agr. Fiji* 20: 19. 1949; J. W. Parham in *Dept. Agr. Fiji Bull.* 30: 113. 1956, *Pl. Fiji Isl.* 309, *fig. 104*. 1964, ed. 2. 409. *fig. 104*. 1972; J. Daniels in *Proc. 12th I. S. S. C. T. Congr.* 1006. 1967; S. Price & J. Daniels in *J. Heredity* 59: 142. 1968.

Perennial, the culms stout, solid, juicy, 3-3.6 m. high; leaf blades up to 1.5 m. long, about 6 cm. broad, the sheaths overlapping, the lower ones falling from culms; panicle oval, large, dense, with many fragile, jointed branches; spikelets alike, paired, narrow, about 5 mm. long, lacking awns, enclosed from base in long, silky hairs.

TYPIFICATION: Linnaeus cited several prior references and then indicated: "*Habitat in Indiae utriusque locis inundatis.*"

DISTRIBUTION: Cultivated in many tropical parts of the world and the most important crop grown in Fiji. It was doubtless brought to Fiji by aboriginal settlers, as it was grown in large quantities by the Fijians when the first European adventurers arrived.

LOCAL NAMES AND USES: As to be expected, there are many Fijian names for the sugarcane: *Ndovu*, *gamma*, *ndovu mbuta*, *ndovu vitho*, *malangele*, *kambakambavale*, and *nanai*. In sugar-growing areas the leaves of the sugarcane are widely used as thatching material for houses and, especially during the harvest, as fodder for cattle. It is not surprising that collectors in Fiji have failed to prepare herbarium material of the sugarcane, although Seeman cites an unnumbered collection; possibly this was not retained.

The commercial cultivation of sugarcane in Fiji commenced in the 1870's, and South Pacific Sugar Mills, Ltd. (known until 1962 as the Colonial Sugar Refining Company, or C.S.R.) built their first mill at Nausori (Tailevu Province, Viti Levu) in 1880. Four mills are now operated by the Company, at Lautoka, Mba, and Penang on Viti Levu and at Lambasa on Vanua Levu. Many other sugar mills were established in the late 1800's, but they all either failed or were taken over by the C.S.R. Company. A collection of Fijian chewing canes and closely related plants (*Erianthus maximus*, *Saccharum edule*, and *Miscanthus floridulus* in the present treatment) is maintained by South Pacific Sugar Mills Ltd., in their sugarcane variety gardens at Lautoka. Similar collections are maintained by the U.S. Department of Agriculture in the World Collection of Sugar Cane Germplasm at Canal Point, Florida, U.S.A., and also by the Government of India at Taliporamba, India.



FIGURE 79. *Saccharum edule*; children of Tailevu Province, Viti Levu, roasting the inflorescence-enclosing sheaths, the specimens vouchered by *Smith* 7246.

2. *Saccharum edule* Hassk. in *Flora* **25**: Beibl. 3. 1842; B.E.V. Parham in *Agr. J. Dept. Agr. Fiji* **19**: 16. 1948, in op. cit. **20**: 19. 1949; J.W. Parham in *Dept. Agr. Fiji Bull.* **30**: 114. 1956, *Pl. Fiji Isl.* 309. 1964, ed. 2. 409. 1972; J. Daniels in *Proc. 12th I. S. S. C. T. Congr.* 1010. 1967; S. Price & J. Daniels in *J. Heredity* **59**: 144. 1968. FIGURE 79.

Flagellaria indica sensu C. H. Wright in *Dept. Agr. Fiji Bull.* **10**: 4. 1918; H. B. R. Parham in *Polynesian Soc. Mem.* **16**: 27. 1943; non L.

Saccharum spontaneum sensu H. R. Surridge in *Agr. J. Dept. Agr. Fiji* **9** (1): 24. 1938; non L.

Erianthus maximus sensu B. E. V. Parham, *Fijian Pl. Names*, 54. 1942; Swallen in *J. Arnold Arb.* **31**: 144. 1950; A. C. Sm. in *Smithsonian Rep.* **1954**: opp. 310. *pl. 8, fig. 1.* 1955; non Brongn.

Erianthus maximus var. "Abortive" Grassl in *J. Arnold Arb.* **27**: 247. *pl. 2, fig. 3.* 1946.

Perennial, the culms 2.5–4 m. high, 2.5–3.7 cm. in diameter, the nodes marked but obscured by leaf sheaths; leaf blades 45–75 cm. long, 2.5–5 cm. broad, tapering to a sharp point; panicle enclosed in leaf sheath, 15–25 cm. long, not opening at all.

TIPIFICATION: Hasskarl based his concept on material from Java.

DISTRIBUTION: Malesia to Fiji. *Saccharum edule* grows wild in Fiji from near sea level to 600 m., although one might question whether or not it originally escaped from aboriginal cultivation. In some places in the interior of Viti Levu the stands may be several hundred acres in extent. Like *Erianthus maximus*, it tolerates poor drainage. April and May are locally regarded as the "nduruka season," although the plant does not truly flower.

LOCAL NAMES AND USES: *Fiji asparagus*, *nduruka*, *nduruka mbambanileka*, *nduruka thonggethongge*, *nduruka kimbo*, *nduruka leka*, *nduruka mimanu*, *nduruka*

tathi, *ndule*. The aborted inflorescence, which remains compacted in the sheath, can be cooked and eaten and is a very popular delicacy when in season. It has been successfully canned and is sometimes available in this form in Fijian markets.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Vicinity of Nalotawa, eastern base of Mt. Evans Range, *Smith* 4309. NAITASIRE: Nanduruloulou, *DA* 9119. TAILEVU: Hills east of Wainimbuka River, in vicinity of Wailotua, *Smith* 7246.

The taxonomy of the *nduruka* has been very confused and is by no means satisfactorily worked out yet. The Fijians recognize numerous cultivars, as suggested by the number of local names mentioned above. Grassl apparently considers this taxon to be a hybrid, probably *Miscanthus floridulus* × *Saccharum robustum*. While this may be the best possible explanation at this time, much work remains, as pointed out by Price and Daniels, before the complex interrelationships between *Saccharum* and *Miscanthus* are adequately understood. For present purposes the traditional binomial *S. edule* is retained.

47. *MICROSTEGIUM* Nees in Lindl. Nat. Syst. Bot. ed. 2. 447. 1836.

Annuals or perennials; leaf blades narrow or lanceolate; racemes with spikelets extending right to base; spikelets in pairs, one sessile, the other subsessile, the upper spikelet falling free, the lower one with pedicel and rachis joint attached.

TYPE SPECIES: *Microstegium willdenovianum* Nees (ING).

DISTRIBUTION: Subtropical Africa and Asia, with about 30 species. One species, *Microstegium glabratum*, is known from Fiji but is only moderately common.

1. *Microstegium glabratum* (Brongn.) A. Camus in Ann. Soc. Linn. Lyon II. 68: 201. 1921; A. C. Sm. in Sargentia 1: 5. 1942; J. W. Parham, Pl. Fiji Isl. ed. 2. 406. 1972. FIGURE 80A & B.

Eulalia glabrata Brongn. in Duperrey, Voy. Coquille Bot.-Phan. 93. 1831.

Pollinia glabrata Trin. in Bull. Sci. Acad. Imp. Sci. Saint-Petersbourg 1: 70. 1836; Summerhayes & Hubbard in Kew Bull. 1927: 28. 1927, in op. cit. 1930: 254. 1930; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 20: 19. 1949; J. W. Parham in Dept. Agr. Fiji Bull. 30: 122. fig. 51. 1956, Pl. Fiji Isl. 309. 1964.

Annual, the culms slender, 15–50 cm. high, the nodes black, conspicuous; leaf blades narrow, lanceolate, fairly pointed, 4–10 cm. long, 5–20 mm. broad; panicle 4–7.5 cm. long, the racemes approximate, 4–9, slender, glabrous, 2.5–7 cm. long; spikelets 2-flowered, about 2.5 mm. long, the lower glume grooved; awn flexuous, often curled, fine, about 12 mm. long.

TYPEIFICATION: The original material described by Brongniart came from the Society Islands.

DISTRIBUTION: Philippine Islands and Pacific Islands. It was first recorded from Fiji from a collection made by Greenwood in 1925. It appears to be an indigenous species which is not common, recorded from near sea level to about 900 m., occurring on riversides, wet sunny slopes, wet clearings, hillsides, and in paddocks, plantations, and clearings on high crests. About 20 collections are known. Flowers have been obtained in months scattered throughout the year.

LOCAL NAME: *Omanumu* (in Nandronga & Navosa); no local use has been noted.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Northern portion of Mt. Evans Range, between Mt. Vatuyanitu and Mt. Natondra, *Smith* 4288; Mt. Tomanivi, *DA* 13033. NANDRONGA & NAVOSA: Lumuka, vicinity of Mbolo, near Vatukarasa, *Degener* 15222. SERUA: Waimbale, near Namboutini, *Degener* 15472. RA: District Farm, Ndombuilevu, *DA* 7816, 7876; Rakiraki, *DA* 7942. NAITASIRE: Naveisamasama, *DA* 1220; Adi Cakobau School, Sawani, *DA* 7653. VANUA LEVU: THAKAUNDROVE: Savusavu Bay region, slopes of Mt. Uluinambathi, *Degener* & *Ordenez* 13932; Valethi, Savusavu, *DA* 8862; Wainigata, *DA* 12016. Summerhayes and Hubbard also record Tothill collections from the islands of Mbatiki, Ngau, and Moala.

48. *ISCHAEMUM* L. Sp. Pl. 1049. 1753, Gen. Pl. ed. 5. 469. 1754.

Annuals or perennials, the culms branching; leaf blades flat; inflorescences digitate or flabellate, the racemes 2-several, digitate or approximate on a short axis; sessile spikelets perfect, awned, the stalked spikelets perfect but not always fertile.

LECTOTYPE SPECIES: *Ischaemum muticum* L. (ING).

DISTRIBUTION: About 50 tropical and subtropical species. Four species have been recorded from Fiji; one is endemic and rare; two are common, and the fourth is restricted to one locality.

KEY TO SPECIES

- Leaf blades linear-lanceolate; racemes firmly appressed together but eventually separating with one flat side each; spikelets yellowish, the lower glume of sessile spikelet strongly transversely ribbed; awn 1.8–2.5 cm. long, spirally twisted in lower half. 1. *I. rugosum*
 Leaf blades with a distinct petiole 5 mm. or more long; racemes appressed at first but separating as maturity approaches; lower glume of sessile spikelet not winged; awn 5–8 mm. long. 2. *I. timorensis*
 Leaf blades lanceolate, hairy, the sheath loose and hairy; racemes paired, the rachis jointed; lower glume of sessile spikelet expanded below middle; awn not more than 12 mm. long. 3. *I. indicum*
 Leaf blades glabrous; racemes 7.5–12.5 cm. long; spikelets hairy; awn of sessile spikelet about 2.5 cm. long. 4. *I. vitiense*

1. *Ischaemum rugosum* Salisb. Icon. Stirp. Rar. 1. t. 1. 1791; Summerhayes & Hubbard in Kew Bull. 1930: 253. 1930; B.E.V. Parham in Agr. J. Dept. Agr. Fiji 13: 50. 1942, in op. cit. 20: 17. 1949, in Proc. 7th Pacific Sci. Congr. 5: 223, 246. 1953; Greenwood in Proc. Linn. Soc. 154: 105. 1943; J.W. Parham in Dept. Agr. Fiji Bull. 30: 140. fig. 60. 1956, in op. cit. 35: 177. fig. 98. 1959; Mune & Parham in Agr. J. Dept. Agr. Fiji 28: 54. fig. 1. 1957, in Dept. Agr. Fiji Bull. 31: 60. fig. 15. 1957, in op. cit. 48: 70. fig. 19. 1967.

Ischaemum rugosum var. *distachyum* sensu Greenwood in J. Arnold Arb. 30: 83. 1949; J.W. Parham, Pl. Fiji Isl. 306. 1964, ed. 2. 405. 1972; non Merr.

Ischaemum rugosum var. *rugosum*; J.W. Parham, Pl. Fiji Isl. 306. 1964, ed. 2. 405. 1972.

Annuals, the culms 30–150 cm. high; leaf blades sparingly pilose on both surfaces, 20–30 cm. long, 9–12 mm. broad; racemes paired, 5–10 cm. long, with one flat side each; spikelets 3–4.5 mm. long, awned, the lower glume of sessile spikelet strongly transversely ribbed, hard, with green, herbaceous, ovate tip; awn 1.8–2.5 cm. long, slender, spirally twisted in lower half; grain small, red-brown.

TYPIIFICATION: The original material came from India.

DISTRIBUTION: India, Burma, Malaya, and Siam to China. It was first recorded in Fiji at Wainikoro, Vanua Levu, in 1929, and has since become a serious weed of rice cultivation in Fiji. It matures at the same time as the rice, so that all the seeds are harvested together. It is a declared noxious weed in Fiji; comments on its control are given by Mune and Parham (loc. cit. 1967). About 25 collections have been seen, but the species is more frequent than this indicates. Flowers occur from February to October. It is found along roadsides and in swamps as well as in rice fields.

LOCAL NAMES AND USE: *Muraina* grass, *tho muraina*. Palatable to stock in young stages.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Near Lautoka golf course, DA 8226. NANDRONGA & NAVOSA: Singatoka Valley Road, DA 9135; Singatoka, DA 2804. SERUA: Nakaulevu, DA 10110; Tokotoko, Navua, DA 9445. NAMOSI: Wainandoi River, DA 2900. RA: Demonstration Farm, Ndombuilevu, DA 7814; Mborotu Indian settlement, DA 7877; Rakiraki, DA 7925. NAITASIRI: Waindravu, DA 9917; Nasinu Training College Farm, DA 9380; Research Station, Koronivia, DA 3973. TAILEVU: Naila, DA 3673. REWA: Suva, C. R. Turbet 24; Nambua, DA 9126. VANUA LEVU: MATHUATA: Near Ndaku, DA 8789. THAKAUNDROVE: Near Mbutha, Mbutha Bay, DA 16876.

2. *Ischaemum timorense* Kunth, Rév. Gram. 369. t. 98. 1830; A. C. Sm. in Bull. Torrey Bot. Club 70: 534. 1943; Greenwood in J. Arnold Arb. 30: 83. 1949; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 20: 17. 1949, in Proc. 7th Pacific Sci. Congr. 5: 232. 1953; J. W. Parham in Dept. Agr. Fiji Bull. 30: 138. fig. 59. 1956, in op. cit. 35: 177. 1959, Pl. Fiji Isl. 306. 1964, ed. 2. 405. 1972.

Perennial, the culms erect, rising from stolons, 30–60 cm. high, mauve-colored, with marked nodes from which long adventitious roots are given off; leaf blades broad, 5–25 cm. long, 10–20 mm. broad, distinctly petiolate; racemes 1.2–5 cm. long; spikelets stalked, 2.5–3.5 mm. long, the awns 5–8 mm. long.

TIPIFICATION: The original material was from the East Indies.

DISTRIBUTION: India and Ceylon into Malesia. *Ischaemum timorense* is reported to have been accidentally introduced into Fiji about 1914 and to have become established on the Waindoi rubber plantation (near mouth of Wainandoi River, Namosi Province, Viti Levu) and on the surrounding hills. It has also been noted near Vunindawa in Naitasiri Province, but is common only in the vicinity of Waindoi, where it occurs up to an elevation of about 90 m. on flat land and open hillsides. Flowers have been noted between June and August.

LOCAL NAME: *Waindoi grass*.

AVAILABLE COLLECTIONS: VITI LEVU: NAMOSI: Waindoi and vicinity, DA 8361, 8370, 11425. NAITASIRI: Nauluwai, Vunindawa, DA 8454; Research Station, Koronivia, DA 3957.

3. *Ischaemum indicum* (Houtt.) Merr. in J. Arnold Arb. 19: 320. 1938; J. W. Parham, Pl. Fiji Isl. 306. 1964, ed. 2. 404. 1972.

Phleum indicum Houtt. Nat. Hist. 198. t. 90, fig. 2. 1782.

Ischaemum ciliare Retz. Obs. Bot. 6: 36. 1791; Swallen in J. Arnold Arb. 31: 141. 1950.

Ischaemum aristatum sensu Summerhayes & Hubbard in Kew Bull. 1927: 25. 1927, in op. cit. 1930: 253. 1930; Greenwood in Proc. Linn. Soc. 154: 105. 1943, in J. Arnold Arb. 30: 83. 1949; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 16: 106. 1945, in op. cit. 20: 17. 1949, in Proc. 7th Pacific Sci. Congr. 5: 230, 232. fig. 12. 1953; J. W. Parham in Agr. J. Dept. Agr. Fiji 19: 103. 1948, in Dept. Agr. Fiji Bull. 30: 138. fig. 58. pl. X, XI. 1956; non L.

Perennial, the culms arising from long stolons, 15–90 cm. high, the nodes bearded; leaf blades 15–30 cm. long, 5–7.5 mm. broad, often red-purple-tinged; racemes paired, 3.5–6.5 cm. long, with jointed, hairy rachis; spikelets about 4.5 mm. long, with an awn 8–12 mm. long.

TIPIFICATION AND NOMENCLATURE: Houttuyn based his species on material from Java. I have been unable to note the tipification of Retzius's later binomial.

DISTRIBUTION: India, southeastern Asia, and parts of Malesia. In Fiji it was first collected from Tambathola, near Lambasa (Mathuata Province, Vanua Levu), by W. E. Lindsay (in Greenwood's herbarium) in 1923, but it was reported to have first appeared there about 1919. *Ischaemum indicum* occurs near sea level in Fiji in pastures and cultivated areas, along roadsides, and on hillsides. There are two forms in Fiji which differ markedly in size but do not appear to have any other differences. More than 40 Fijian collections are available. Flowers occur throughout the year but are mostly found in the cool season, between June and August.

LOCAL NAMES AND USES: *Mbatiki blue grass* (large form), *small Mbatiki* or *mbalanga grass* (small form). It is a useful pasture and lawn grass, but is sometimes a weed of cultivation. However, it smother weeds and therefore is useful for pasture when management standards are low.

REPRESENTATIVE COLLECTIONS: VITI LEVU: NANDRONGA & NAVOSA: Agricultural Station, Nathotholevu, Singatoka, DA 8310. SERUA: Ndeumba, DA 11451; Ranandi Beach, Ndeumba, DA 17207. NAMOSI:

Wainiuraura, *DA 8439*. RA: Ndombuilevu Farm, *DA 7869*. NAITASIRI: Adi Cakobau School Farm, Sawani, *DA 7639*; Nasinu Training College Farm, *DA 8029*; Research Station, Koronivia, *DA 3956*; Nanduruloulou, *DA 436*; Mbatiki, Nanduruloulou, *DA 2623*. TAILEVU: Ratu Kadavulevu School Farm, Londoni, *DA 7763*; Korovou, *DA 3282*; near Nausori, *Greenwood 1138*. REWA: Nakaile, *DA 8606*; Suva, *DA 9146*. VANUA LEVU: THAKAUNDROVE: Mbalanga Estate, *DA 8816*; Marava Estate, *DA 8824*.

4. *Ischaemum vitiense* Summerhayes in Kew Bull. 1930: 253, 264. 1930; J. W. Parham in Dept. Agr. Fiji Bull. 30: 140. 1956, Pl. Fiji Isl. 307. 1964, ed. 2. 405. 1972.

Perennial, the culms robust, erect, about 45 cm. high; leaf blades glabrous, up to 30 cm. long, 6–14 mm. broad; racemes paired, 7.5–12.5 cm. long, fragile; spikelets 8–9 mm. long, sessile, hairy, the awn of sessile spikelet about 2.5 cm. long.

TIPIFICATION: The holotype (K) is *Tothill 152*, collected June 30, 1927, on the island of Fulanga.

DISTRIBUTION: Known only from the type collection. Only two clumps were seen by Tothill, and no subsequent botanist has collected it.

49. *SORGHUM* Moench, Meth. Pl. 207. 1794. Nom. cons.

Annuals or perennials; panicle terminal, consisting of 1–5 disarticulating racemes; rachis disarticulating in wild species but usually not in cultivated species; spikelets paired or in threes, dissimilar, the sessile spikelets bisexual and seed-bearing, the pedicelled ♂ or neuter.

TYPE SPECIES: *Sorghum bicolor* (L.) Moench (*Holcus bicolor* L.) (ING).

DISTRIBUTION: About 60 tropical and subtropical species are recognized. Five species have been recorded from Fiji, of which only one, *Sorghum halepense*, is naturalized. Three others are known in cultivation. The fifth, *S. sudanense* Stapf, has been grown under trial without success and is, therefore, not further considered. I discussed the *Sudan grass* in Dept. Agr. Fiji Bull. 30: 117. 1956; it is represented by *DA 7859, 8467, 9115, and 9168*, all from trial plots, and by *FDA 13919*, presumably one of the original introduction numbers.

The taxonomy of the cultivated species is extremely confused.

KEY TO SPECIES

Perennials.

- Rhizomes well developed, extensively creeping, the culms slender; leaf blades narrow, up to 2 cm. broad; panicle small, up to 25 cm. long and 5 cm. broad, the lower racemes 5–8 cm. long, the stalked spikelets deciduous when mature. 1. *S. halepense*
Rhizomes absent; leaf blades up to 7.5 cm. broad; panicle open, 60–120 cm. long, with numerous, ascending racemes 5–30 cm. long; sessile spikelets elliptic-lanceolate, acuminate, 6–7 mm. long. 2. *S. verticilliflorum*

Annuals.

- Panicle dense, 30–90 cm. long; sessile spikelets broadly obovate, 4–5.5 mm. long, the glumes of sessile spikelets coriaceous with nerves obscure except at tip, the upper lemma awned; grains usually exposed at top. 3. *S. bicolor*
Panicle compact, about 20 cm. long and 7.5 cm. broad; spikelets persistent, the glumes of sessile spikelets often rather thin, striately nerved to middle or below middle, the upper lemma almost awned; grain enclosed or only slightly exposed. 4. *S. vulgare*

1. *Sorghum halepense* (L.) Pers. Syn. Pl. 1: 101. 1805; C. H. Wright in Dept. Agr. Fiji Circ. 3: 41. 1922; Summerhayes & Hubbard in Kew Bull. 1927: 27. 1927; Greenwood in Proc. Linn. Soc. 154: 106. 1943, in J. Arnold Arb. 30: 83. 1949; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 20: 19. 1949, in Proc. 7th Pacific Sci. Congr. 5: 223, 246. 1953; Mune & Parham in Agr. J. Dept. Agr. Fiji 26: 30. fig.

1955, in Dept. Agr. Fiji Bull. 31: 56. fig. 14. 1957; J. W. Parham in Dept. Agr. Fiji Bull. 30: 115. fig. 48. 1956, in op. cit. 35: 170. fig. 94. 1959.

Holcus halepensis L. Sp. Pl. 1047. 1753.

Perennial, the culms slender, 90–150 cm. high, from a long, creeping rhizome; leaf blades narrow, 15–50 cm. long, 8–20 mm. broad; sessile spikelets oblong-lanceolate, about 5 mm. long, tawny to purple-tinged, slightly hairy, with a deciduous, geniculate awn about 1.2 cm. long, the stalked spikelets lanceolate, 5–6 mm. long, pale to deep purple.

TYPIFICATION: After noting two prior references, Linnaeus stated: "*Habitat in Syria, Mauritania.*"

DISTRIBUTION: A native of tropical Asia now widespread in many tropical and warm regions. It was, according to Greenwood, first introduced into Fiji about 1895 as a fodder grass and became a serious weed of sugarcane fields in the Mba area. It was also noted in 1929 at Lambasa, Vanua Levu, as a weed of canefields.

LOCAL NAME AND USES: *Johnson grass*. Although introduced as a forage plant, it is not relished by stock and is claimed to be poisonous during early seedling growth and when stunted by drought. It is spread during cultivation, when the extensive rhizomes are cut up and distributed, and by seed. Flowers have been noted during months scattered throughout the year.

Two forms have been recorded from Fiji: the above notes may be taken to apply equally to both, except for the presence or absence of an awn.

KEY TO FORMS

- Spikelets awned. 1a. *f. halepense*
Spikelets not awned. 1b. *f. muticum*

1a. *Sorghum halepense* f. *halepense*; J. W. Parham, Pl. Fiji Isl. 311. 1964, ed. 2. 411. 1972; Mune & Parham in Dept. Agr. Fiji Bull. 48: 74. fig. 20. 1967.

The typical form, with a deciduous, geniculate awn about 1.2 cm. long. It is a widespread and serious weed of cultivation and was declared a noxious weed in 1947.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Lautoka, DA 2519, p. p.; Tonge road, Mba, DA 10407, 10419; King's Road between Mba and Tavua, DA 8188. REWA: Noxious weed garden of the Suva Herbarium, DA 10811. VANUA LEVU: MATHUATA: Tambuthola-Wailevu boundary, DA 8732; Namara road, Lambasa, DA 10452.

1b. *Sorghum halepense* f. *muticum* (Hackel) Hubbard in Hook. Icon. Pl. 34: 4. sub t. 3364. 1938; J. W. Parham in Dept. Agr. Fiji Bull. 30: 117. 1956, in op. cit. 35: 171. 1959, Pl. Fiji Isl. 311. 1964, ed. 2. 411. 1972; Mune & Parham in Dept. Agr. Fiji Bull. 31: 56. 1957, in op. cit. 48: 74. 1967.

Andropogon sorghum subsp. *halepensis* var. *halepensis* subvar. *muticus* Hackel in DC. Monogr. Phan. 6: 502. 1889.

Andropogon halepensis f. *muticus* Aschers. & Graebner in Aschers. Syn. Mitteleur. Fl. 2: 47. 1898.

Differs from the typical form in having the awns not developed; it is an equally serious weed.

TYPIFICATION: The citation originally given by Hackel was "inter genuinum hinc inde, in India illo frequentior."

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Lautoka, DA 2519, p. p.; between Mba and Lautoka, DA 8539; Mba town, DA 10751; Votua, Mba, DA 10438.

2. *Sorghum verticilliflorum* (Steudel) Stapf in Prain, Fl. Trop. Afr. 9: 116. 1917; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 20: 20. 1949, in Proc. 7th Pacific Sci. Congr. 5: 239. fig. 9. 1953; J. W. Parham in Dept. Agr. Fiji Bull. 30: 118. pl. VIII. 1956, Pl. Fiji Isl. 311. 1964, ed. 2. 411. 1972.

Andropogon verticilliflorus Steudel, Syn. Pl. Glum. 1: 393. 1854.

Perennial, the culms 90–120 cm. or more high; leaf blades 45–90 cm. long, 5–7.5 cm. broad, tapering to a fine point; spikelets golden-brown in color, turning black at maturity, 6–7 mm. long, the lower glume lacking an awn or, on a few spikelets, mucronate.

TIPIFICATION: The original material came from “Ins. Borbon.”, i.e. La Réunion, Mascarene Islands.

DISTRIBUTION: East Africa and Indian Ocean islands. It was introduced into Fiji from Trinidad for trial as a fodder plant. It is not common, only occasional plants being seen in cultivation. Flowers have been noted in May.

LOCAL NAME AND USE: *Kavirondo sorghum*. It is sparingly grown as a fodder grass.

AVAILABLE COLLECTION: VITI LEVU: NAITASIRI: Plant Introduction and Quarantine Station, Nanduroulou, DA 9121.

3. *Sorghum bicolor* (L.) Moench, Meth. Pl. 207. 1794; Summerhayes & Hubbard in Kew Bull. 1927: 27. 1927; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 20: 19. 1949; J. W. Parham in Dept. Agr. Fiji Bull. 30: 115. 1956, Pl. Fiji Isl. 311. 1964, ed. 2. 411. 1972.

Holcus bicolor L. Mant. Pl. Alt. 301. 1771.

Annual, the culms robust, up to 4.3 m. high; leaf blades lanceolate, 30–60 cm. long, 3.7–7.5 cm. broad; panicle dense, narrow, oblong, the branches tough; spikelets paired, falling entire at maturity.

TIPIFICATION: The original material was said to have come from Persia.

DISTRIBUTION: Probably originally a native of Asia, but now widespread.

LOCAL NAME AND USE: *Broom corn*. A broom-making industry, utilizing the inflorescences of *Sorghum bicolor* grown in the Singatoka Valley, was established in 1963 and is now a flourishing business. Although the species is cultivated on quite a large scale in the Valley, there are no supporting herbarium records.

4. *Sorghum vulgare* Pers. Syn. Pl. 1: 101. 1805; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 20: 20. 1949; J. W. Parham in Dept. Agr. Fiji Bull. 30: 117. 1956, Pl. Fiji Isl. 311. 1964, ed. 2. 411. 1972.

Annual, the culms to 3 m. high; panicle compact; spikelets persistent.

TIPIFICATION AND NOMENCLATURE: The original material was said to have come from India. Linnaeus described this species as *Holcus sorghum* L. (Sp. Pl. 1047. 1753), but the epithet cannot be used in the genus *Sorghum*.

DISTRIBUTION: Widely cultivated in the warm regions of the world as a cereal and a fodder grass, and grown on a small scale in Fiji for many years.

LOCAL NAMES AND USES: *Sorghum*, *Guinea corn*, *jowar* (Hindi). In recent years the Fiji Department of Agriculture has introduced many new hybrid varieties for trial, and efforts have been made to persuade farmers in sugar areas to replace maize with grain sorghum because the disease *Sclerospora sacchari*, common on maize, is also a serious disease of the sugarcane.

AVAILABLE COLLECTION: VITI LEVU: NANDRONGA & NAVOSA: Singatoka Valley, DA 17426.

Seemann (in Bonplandia 9: 261. 1861, Viti, 444. 1862) listed *Sorghum vulgare* Pers. and his own collection number 689. However, this mention is omitted from *Flora Vitiensis*.

50. *VETIVERIA* Bory in Lem. in Bull. Sci. Soc. Philom. Paris 1822: 43. 1822.

Perennial, the culms coarse, glabrous, arising from stout rhizomes; panicle generally contracted, the racemes slender, long, solitary on long, filiform stalks, borne in whorls on the elongated axis of panicle; spikelets lacking awns, filiform, the rachis disarticulating tardily.

TYPE SPECIES: *Vetiveria odoratissima* Bory, nom. illeg. (*Andropogon squarrosus* L. f.) (ING). The correct combination in *Vetiveria* is not indicated on the current ING card.

DISTRIBUTION: About ten species in tropical Africa, Asia, and Australia. Only one species, *Vetiveria zizanioides*, has been introduced into Fiji, where it is naturalized.

1. *Vetiveria zizanioides* (L.) Nash in Small, Fl. Southeast. U.S. 67. 1903; Summerhayes & Hubbard in Kew Bull. 1927: 28. 1927, in op. cit. 1930: 254. 1930; B.E.V. Parham, Fijian Pl. Names, 54. 1942, in Agr. J. Dept. Agr. Fiji 20: 20. 1949; Greenwood in J. Arnold Arb. 25: 403. 1944; J.W. Parham in Dept. Agr. Fiji Bull. 30: 121. fig. 50. 1956, Pl. Fiji Isl. 312. 1964, ed. 2. 413. 1972.

Phalaris zizanioides L. Mant. Pl. Alt. 183. 1771.

Perennial, the culms stout, up to 3 m. high; leaf blades narrow, glabrous, 30–90 cm. long, 5–12 mm. broad, tapering at length to a fine point, the margins scabrous; panicle usually contracted, 22–37 cm. long, the branches whorled, fragile, jointed, ascending, appressed, 5–7.5 cm. long; spikelets paired, about 4 mm. long, similar, one sessile, one stalked, falling entire at maturity, 2-flowered, the upper floret of sessile spikelet alone perfect, the others either ♂ or sterile, the glumes with minute, prickly, wartlike projections, the glume of stalked spikelet almost smooth.

TYPEFIICATION: The original material came from India.

DISTRIBUTION: Southeastern Asia to tropical Africa. *Vetiveria zizanioides* was introduced into Fiji in 1907 and was grown under trial for the production of vetiver oil. It is cultivated in gardens but is also escaped and naturalized, occurring along roadsides and contour lines. Flowers have been noted from February to August.

LOCAL NAMES AND USES: *Vetiver grass*, *khas khas* (Hindi), *garara* (Hindi), *muli-muli* (Fijian name recorded only on Matuku). It is used extensively to bind rice bunds, as well as for contour lines and other conservation practices. The leaves are often used for thatching houses, and occasionally for making fine mats. On the other hand it may be considered a roadside weed.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Lautoka, Greenwood 228, DA 8206; Sambeto Valley, DA 8273; Vatutu, Nandi, DA 8565; north of Natalau, near Lautoka, Degener 15013. NANDRONGA & NAVOSA: Lombau Farm, DA 7984. RA: District Farm, Ndombuilevu, DA 7874. NAITASIRE: Koronivia, DA 7466; Nanduruloulou, DA 452, 2502. REWA: Suva Point, DA 6087, 7485, 7542. Summerhayes and Hubbard have also reported a Tothill collection from Matuku.

51. *CHRYSOPOGON* Trin. Fund. Agrost. 187. 1820. Nom. cons.

Perennials or annuals; panicle open with reduced raceme (3 spikelets) borne at apices of long, slender branches; spikelets in threes, the sessile one perfect, two stalked and sterile, the glumes coriaceous, the fertile and sterile lemmas hyaline, thin, the sterile lemma awned.

TYPE SPECIES: *Chrysopogon gryllus* (L.) Trin. (*Andropogon gryllus* L.). Typ. cons. (ICBN; ING).

DISTRIBUTION: Tropical and subtropical regions, especially of the Old World, with about 25 species. One species, *Chrysopogon aciculatus*, is common in Fiji and was probably an aboriginal introduction.

1. *Chrysopogon aciculatus* (Retz.) Trin. Fund. Agrost. 188. 1820; C. H. Wright in Dept. Agr. Fiji Circ. 3: 41. 1922; Summerhayes & Hubbard in Kew Bull. 1927: 28. 1927, in op. cit. 1930: 254. 1930; B. E. V. Parham, Fijian Pl. Names, 54. 1942, in Agr. J. Dept. Agr. Fiji 20: 16. 1949, in Proc. 7th Pacific Sci. Congr. 5: 230, 236. 1953; Greenwood in Proc. Linn. Soc. 154: 106. 1943; J. W. Parham in Dept. Agr. Fiji Bull. 30: 119. fig. 49. 1956, in op. cit. 35: 173. fig. 95. 1959, Pl. Fiji Isl. 302. 1964, ed. 2. 398. 1972.

Andropogon aciculatus Retz. Obs. Bot. 5: 22. 1788; Seem. in Bonplandia 9: 261, as *A. acicularis*. 1861, Viti, 444, as *A. acicularis*. 1862, Fl. Vit. 320. 1868.

Perennial, the culms erect from creeping base, 15–37 cm. high; leaves densely tufted, the blades glabrous, 2.5–15 cm. long, 3–5 mm. broad; panicle narrow, 2.5–7.5 cm. long, the branches 1–3.5 cm. long; spikelets falling entire at maturity, the stalked spikelets short-awned.

TYPEIFICATION: The species was originally described from Amboina, Malesia.

DISTRIBUTION: Tropical parts of Asia, Malesia, Australia, and into the Pacific. It was first recorded from Fiji by Seemann. It is very common throughout the archipelago, more than 50 collections being available, occurring from sea level to about 900 m. on open hillsides, roadsides, seashores, and in lawns and pastures.

LOCAL NAMES AND USES: *Seed grass*, *golden beard grass*, *kase*. The species forms a rough turf in lawns and pastures, being a common weed of cultivation and waste places. The sharp awns on the spikelets can become attached to anything that brushes past and can cause festering sores on the heads and feet of animals.

REPRESENTATIVE COLLECTIONS: VITI LEVU: Mba: Near Lautoka golf course, DA 8225; Votualevu, Nandi, DA 10707; northern portion of Mt. Evans Range between Mt. Vatuyanitu and Mt. Natondra, Smith 4341; Mt. Nangaranambuluta, east of Nandarivatu, DA 2447. NANDRONGA & NAVOSA: Singatoka, DA 3497; Lombau Farm, DA 7986. SERUA: Ngaloa Village, Smith 9453; Naitonitoni, Navua, DA 8648. RA: Rakiraki, DA 7938; Ellington, DA 7900; District Farm, Ndombulevu, DA 7304. NAITASIRE: Nauluwai, Vinindawa, DA 8422; Nasinu Training College, DA 9341. TAILEVU: Waindalithe, DA 7671; Matavatathou, DA 7783. REWA: Lokia, DA 8596. MBENGGA: DA 9072. VANUA LEVU: MBUA: Mbua Village, DA 5025. MATHUATA: Tambia, DA 8757. THAKAUNDROVE: Savusavu, DA 8851. FIJI without definite locality, Seeman 686 (Vanua Levu, Lakemba, Ovalau). Additionally Summerhayes and Hubbard have reported the occurrence of *Chrysopogon aciculatus* on the islands of Vatulele, Moturiki, Koro, Mbatiki, Ngau, Taveuni, Moala, Totoya, Matuku, Kanathea, Vanua Mbalavu, and Mango.

52. *CYMOPOGON* Spreng. Pl. Min. Cogn. Pugill. 2: 14. 1816.

Perennials, densely tufted, usually aromatic; inflorescence decompose, with racemes in pairs subtended by a leaflike spathe, forming a spatheate panicle; lowermost pair of one or both spikelets sterile and similar to stalked spikelets above, the fertile spikelets sessile, compressed dorsally, flat or grooved, sharply 2-keeled, the fertile lemma narrow, the awn from between teeth of lobe.

LECTOTYPE SPECIES: *Cymbopogon schoenanthus* (L.) Spreng. (*Andropogon schoenanthus* L.) (ING).

DISTRIBUTION: Tropical and subtropical Africa and Asia, with about 60 species. Two species, *Cymbopogon refractus* and *C. coloratus*, are naturalized in Fiji. A third species, *C. martinii* (Roxb.) Wats., was introduced into Fiji for trial in 1955 but failed to become established. It is represented by DA 8334 and 10130 from the Plant

Introduction and Quarantine Station, Nanduruloulou, Naitasiri, Viti Levu (cf. J. W. Parham, *Pl. Fiji Isl.* ed. 2. 399. 1972).

USEFUL TREATMENT OF GENUS: Blake, S. T. Revision of the genera *Cymbopogon* and *Schizachyrium* (Gramineae) in Australia. *Contr. Queensland Herb.* 17: 1-70. 1974.

KEY TO SPECIES

Spikelets lacking awns; panicle linear, erect, loose; spathes green. 1. *C. refractus*
Spikelets awned; panicle oblong, spreading, dense; spathes reddish brown. 2. *C. coloratus*

1. ***Cymbopogon refractus*** (R. Br.) A. Camus in *Rev. Int. Bot. Appl. Agr. Trop.* 1: 279. 1921; Summerhayes & Hubbard in *Kew Bull.* 1927: 30. 1927, in op. cit. 1930: 255. 1930; B. E. V. Parham, *Fijian Pl. Names*, 54. 1942, in *Agr. J. Dept. Agr. Fiji* 20: 16. 1949, in *Proc. 7th Pacific Sci. Congr.* 5: 235. 1953; J. W. Parham in *Dept. Agr. Fiji Bull.* 30: 131. 1956, *Pl. Fiji Isl.* 302. 1964, ed. 2. 399. 1972; S. T. Blake in *Contr. Queensland Herb.* 17: 57. 1974.

Andropogon refractus R. Br. *Prodr. Fl. Nov. Holl.* 202. 1810; Seem. in *Bonplandia* 9: 261, as *A. refractum*. 1861, Viti, 444, as *A. refractum*. 1862, *Fl. Vit.* 320. 1868.

Cymbopogon nardus sensu B. E. V. Parham in *Agr. J. Dept. Agr. Fiji* 20: 16. 1949, in *Proc. 7th Pacific Sci. Congr.* 5: 224, 231. 1953; J. W. Parham in *Dept. Agr. Fiji Bull.* 30: 131, fig. 55. 1956, in op. cit. 35: 175. 1959, *Pl. Fiji Isl.* 302. 1964; non Rendle.

Perennial, the culms 30-90 cm. high, the nodes black, conspicuous; leaf blades narrow, up to 30 cm. long and 2.5 mm. broad, the margins scabrous; panicle linear, 15-30 cm. long with spikelike, paired racemes supported by leafy bract 1.8-2.5 cm. long; spikelets paired, 7-8 mm. long, dissimilar, one sessile, one stalked, falling entire at maturity.

TYPE: The holotype is *Brown (6177)* (BM), from Port Jackson, Australia.

DISTRIBUTION: A native of Australia but now extending into the Pacific as far as the Tuamotus and Hawaii. It was first recorded in Fiji from Seemann's 1860 visit and is now moderately common throughout the archipelago from sea level to about 900 m., occurring on open hillsides, reed- and fern-covered slopes, in thin forest, on rocky shores and sandy beaches, and in waste places. More than 30 Fijian collections are available. Flowers may be expected at any time of the year.

LOCAL NAMES AND USE: *Barbed wire grass*, *ramba*, *othangithangi*, *thoyangiyangi*, *citronella grass*. The lemon-scented leaves are sometimes used for making tea.

REPRESENTATIVE COLLECTIONS: YASAWAS: WAYA: Nangua, *St. John 18102*. VITI LEVU: MBA: Vakambuli, near Lautoka, *DA 8237*; Sambeto Valley, *DA 8272*; vicinity of Nalotawa, eastern base of Mt. Evans Range, *Smith 4266*; Government Station, Mba, *DA 8199*; Korovou, east of Tavua, *Degener 14960*; Nandarivatu, *DA 2092*. NANDRONGA & NAVOSA: Agricultural Station, Nathotholevu, Singatoka, *DA 5981*. RA: Government Station, Vaileka, *DA 8104*. NAITASIRI: Navuso Experiment Station, *DA 2501*. TAILEVU: Matavatathou, *DA 9955*. KANDAVU: Vunisea, *DA 8982*; Ngaloa Island, *DA 9078*. VANUA LEVU: MATHUATA: Tambia, *DA 8723*; Ndaku road, *DA 8794*; southern base of Mathuata Range, north of Natua, *Smith 6810*. MOALA: North coast, *Smith 1390*. OLORUA: Near beach, *Bryan 521*. FIJI without definite locality, *Seemann 685* (Viti Levu, Lakemba, etc.). Summerhayes and Hubbard also report the species from the islands of Taveuni, Kanathea, Totoya, and Matuku.

It seems possible that Seemann's references (in *Bonplandia* 9: 261. 1861, Viti, 444. 1862) to *Andropogon schoenanthus* L. were misidentifications of *Cymbopogon refractus*. He recorded his collection number 687 and the local name *thomboi*, here referred to the following species. *Seemann 687* is not accounted for in *Flora Vitiensis*.

2. ***Cymbopogon coloratus*** (Hook. f.) Stapf in *Kew Bull.* 1906: 321. 1906; C. H. Knowles in *Dept. Agr. Fiji Bull.* 6: 1. 1913; Summerhayes & Hubbard in *Kew Bull.* 1927: 30. 1927, in op. cit. 1930: 255. 1930; B. E. V. Parham, *Fijian Pl.*

Names, 54. 1942; Greenwood in J. Arnold Arb. **25**: 403. 1944; J. W. Parham, Pl. Fiji Isl. ed. 2. 399. 1972.

Andropogon coloratus Nees in Wight, Cat. Spec. Ind. Pl. no. 1703, nom. nud. 1833.

Andropogon nardus var. *coloratus* Hook. f. Fl. Brit. Ind. 7: 206. 1896.

Cymbopogon citratus sensu B. E. V. Parham in Agr. J. Dept. Agr. Fiji **20**: 16. 1949; J. W. Parham in Dept. Agr. Fiji Bull. **30**: 128. 1956, Pl. Fiji Isl. 302. 1964; non Stapf.

Perennial, the culms 90–150 cm. high; leaf blades 15–90 cm. long, 5–15 mm. broad, glabrous, tapering, the margins scabrous; panicle dense, spreading, 22–45 cm. long, the racemes numerous, about 1.2 cm. long, supported by bracts 10–15 mm. long; sessile spikelets 5–6 mm. long, the hairs on joints of pedicels gray, conspicuous; awn about 10 mm. long.

TIPIFICATION: On the basis of Hooker's and Stapf's discussions, the lectotype may be construed as *Wight 1703*, from southern India.

DISTRIBUTION: India. Knowles states that this species was introduced into Fiji in error, as seeds of *Cymbopogon citratus* (DC.) Stapf had been requested. It was initially grown for trial at the Nasinu Experimental Station, and later at the Lautoka Station. Samples of the oil were sent to London for evaluation in 1909 and it was found to be similar to a mixture of lemon grass oil and citronella oil. Specimens were then sent to Kew, where the species was identified as *C. coloratus*, a species which had not previously been used commercially for the production of volatile oil. Work on this crop was eventually abandoned, but some plants escaped and it is now moderately common on roadsides and in waste places, although apparently restricted to Viti Levu. It is especially common in the vicinity of Natambua, near Lautoka, where some of the early plantings were made. Flowers have been noted between May and July.

LOCAL NAMES AND USE: *Lemon grass*, *thomboi*. The lemon-scented leaves are used for making tea.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Near Lautoka golf course, *DA 8208*. NAITASIRI: King's Road, near Nasinu, *DA 2557*. REWA: Suva Point, *DA 3633*.

53. *HYPARRHENIA* Anderss. ex Stapf in Prain, Fl. Trop. Afr. **9**: 291. 1919.

Perennials with tall culms; racemes paired with spathes, more or less crowded on slender stalks forming a fairly large, elongate inflorescence; spikelets paired, the lower pairs alike, sterile, lacking an awn, the fertile spikelets 1–several on each raceme, terete or flattened on back, the base usually elongated into a sharp callus, the fertile lemma with a strong geniculate awn, the sterile spikelets lacking an awn.

LECTOTYPE SPECIES: *Hyparrhenia pseudocymbaria* (Steudel) Stapf (*Anthistriria pseudocymbaria* Steudel) (ING).

DISTRIBUTION: Mediterranean region, Africa, and Arabia, with about 75 species. One species, *Hyparrhenia rufa*, is reported to be naturalized in Fiji. Four other species have been introduced for trial without success (cf. J. W. Parham, Pl. Fiji Isl. ed. 2. 403, 404. 1972). These species, together with herbarium vouchers collected at the Plant Introduction and Quarantine Station, Nanduruloulou, Naitasiri Province, Viti Levu, are: *H. diandra* Stapf (*DA 10129*), *H. familiaris* Stapf (*DA 10135*), *H. filipendula* (Hochst.) Stapf (*DA 10137*), and *H. pachystachya* Stapf (*DA 10136*).

1. *Hyparrhenia rufa* (Nees) Stapf in Prain, Fl. Trop. Afr. **9**: 304. 1919; B. E. V. Parham in Agr. J. Dept. Agr. Fiji **10**: 115, as *H. rufus*. 1939, in op. cit. **20**: 17. 1949; J. W. Parham in Dept. Agr. Fiji Bull. **30**: 131. 1956, Pl. Fiji Isl. 306. 1964, ed. 2. 404. 1972.

Trachypogon rufus Nees, Agrost. Brasil. 345. 1829.

Perennial, the culms 37–75 cm. high; leaf blades 10–30 cm. long, about 5 mm. broad; inflorescence 20–40 cm. long, the racemes on slender, flexuous peduncles, paired, 1.8–2.5 cm. long, pubescent with dark red hairs, the stalks and rachis joints ciliate with red hairs, the awns twisted, 1.2–2.5 cm. long.

TYPIFICATION: The original material came from Brazil.

DISTRIBUTION: A very common species throughout tropical Africa, but also introduced into many parts of southeastern Asia and South America. *Hyparrhenia rufa* was introduced into Fiji by R. B. Howard in 1938 and has been reported as escaped and naturalized, but apparently it is uncommon. Flowers have been noted in May, July, and December.

LOCAL NAME: *Jaragua* (Hindi).

AVAILABLE COLLECTIONS: VITI LEVU: NANDRONGA & NAVOSA: Agricultural Station, Nathotholevu, Singatoka, DA 3586, 3632, 7235, 8315.

54. *HETEROPOGON* Pers. Syn. Pl. 2: 533, 1807.

Annuals or perennials, the culms fairly robust; racemes solitary and terminal, the lower part of rachis bearing paired ♂ spikelets with sharp, barbed callus below fertile spikelet, the stalked spikelet falling readily, the lowermost spikelets sterile or ♂.

LECTOTYPE SPECIES: *Heteropogon glaber* Pers., nom. illeg. (*Andropogon allioni* DC.: *H. allionii* (DC.) Roemer & Schultes) (ING).

DISTRIBUTION: A tropical genus of about twelve species. Only one species, *Heteropogon contortus*, has been reported from Fiji; apparently it was either an aboriginal or a very early European introduction, as it is now naturalized and widespread in many places.

1. *Heteropogon contortus* (L.) Beauv. ex Roemer & Schultes, Syst. Veg. 2: 836.

1817; Summerhayes & Hubbard in Kew Bull. 1927: 30. 1927, in op. cit. 1930: 255. 1930; Greenwood in J. Arnold Arb. 25: 403. 1944; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 20: 17. 1949, in Proc. 7th Pacific Sci. Congr. 5: 231–236. 1953; J. W. Parham in Dept. Agr. Fiji Bull. 30: 133. fig. 56. 1956, in op. cit. 35: 175. fig. 97. 1959, Pl. Fiji Isl. 306. 1964, ed. 2. 403. 1972.

Andropogon contortum L. Sp. Pl. 1045. 1753.

Perennial, tufted, the culms erect or ascending, branched, 30–90 cm. high; sheaths smooth, keeled, the leaf blades flat, narrow, 7.5–22 cm. long, 2.5–7.5 mm. broad; inflorescence 3.7–7.5 cm. long, one-sided; spikelets paired, 2-flowered, one sessile, one stalked, on jointed rachis, covered with tubercle-based hairs, the basal portion of raceme with 3–10 pairs of awnless, similar, persistent, ♂ or sterile spikelets; upper portion of raceme with 12 pairs of dissimilar, deciduous, awned spikelets, only the upper floret of sessile spikelet perfect, the sessile spikelets about 6 mm. long, awned, the awn bent, dark reddish brown in color, 5–10 cm. long.

TYPIFICATION: After giving several prior references, Linnaeus noted: "*Habitat in India*."

DISTRIBUTION: Widely distributed in the tropics and reasonably common in Fiji from sea level to about 250 m., occurring on open hillsides and along roadsides in the intermediate zones, also on dryish grassy plains and cliff ledges in thin forest. Flowers have been noted from April to August and also in December.

LOCAL NAMES AND USES: *Spear grass*, *tanglehead*, *othangithangi* (the last often used for *Cymbopogon refractus*, which sometimes grows in association with *Heteropogon contortus*). The present species is reported to be palatable to stock when young, but on the other hand it is generally regarded as a pasture weed; the awned spikelets are troublesome to cattle and other animals.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Sambeto Valley, DA 8267, 8271, 8274; Korovou, east of Tavua, *Degener 14961*. RA: Yaggara Farm, DA 8493; Nanunu-i-thake, DA 2752, 2753; Vaileka, DA 8105; road to Thamboni from Vaileka, DA 8130, 8135. VANUA LEVU: MATHUATA: Southern base of Mathuata Range, north of Natua, *Smith 6809*.

55. *Themeda* Forssk. Fl. Aegypt.-Arab. 178. 1775.

Annuals or perennials, the culms usually robust; panicle compound, leafy, the inflorescence a fan-shaped cluster of several racemes each subtended by a leaflike spathe, the whole subtended or partially enclosed by a larger spathe; racemes of 2 approximate pairs of sessile, awnless, ♂ or sterile spikelets and a single, fertile, awned spikelet with a pair of stalked, sterile or ♂ spikelets forming a pointed callus below the fertile one.

TYPE SPECIES: *Themeda triandra* Forssk. (ING).

DISTRIBUTION: Tropical and subtropical parts of Africa and Asia, with about ten species. Two species have become naturalized in Fiji.

USEFUL TREATMENT OF GENUS: Blake, S. T. *Themeda*, *Iseilema* and *Germainia*. Proc. Roy. Soc. Queensland **80**: 81-82. 1969.

KEY TO SPECIES

Spikelets arranged in large, fan-shaped clusters 4-5 cm. long (excluding awns); awns about 5 cm. long; subtending spathes densely covered with tubercle-based hairs. 1. *T. arguens*
Spikelets arranged in smaller clusters 1.5-3 cm. long, crowded on racemes; awns 3-5 cm. long; subtending spathes with few tubercle-based hairs along margin. 2. *T. quadrivalvis*

1. *Themeda arguens* (L.) Hackel in DC. Monogr. Phan. 6: 657. 1889; J. W. Parham, Pl. Fiji Isl. ed. 2. 412. 1972.

Stipa arguens L. Sp. Pl. ed. 2. 1: 117. 1762.

Culms purple-tinged, 60-90 cm. high; leaf blades 15-30 cm. long, 3-5 mm. broad; panicle compound, the leaflike spathes 3-8 cm. long, densely hairy; spikelets 5-7 mm. long; awns about 5 cm. long, twisted.

TYPIFICATION: The originally described material came from India.

DISTRIBUTION: Southeastern Asia and other tropical areas. It was fairly recently introduced into Fiji for trial but appears to have escaped and become naturalized along roadsides in one or two isolated areas, where it is slowly spreading, between sea level and about 30 m. Flowers have been noted between May and August.

USE: This grass is reported to be readily grazed when young, but the strong awns must make it unpalatable when it is in flower. No local name seems to be in use.

AVAILABLE COLLECTIONS: VITI LEVU: NAITASIRI: Plant Introduction and Quarantine Station, Nanduruloulou, DA 8324. REWA: Domain road, Suva, DA 3127. TAVEUNI: Road opposite Waitavala Estate, DA 16900.

2. *Themeda quadrivalvis* (L.) Kuntze, Rev. Gen. Pl. 2: 794. 1891; C. H. Wright in Dept. Agr. Fiji Circ. 3: 40-43. 1922; Summerhayes & Hubbard in Kew Bull. 1927: 31. 1927; Greenwood in J. Arnold Arb. 25: 404. 1944, in op. cit. 30: 83. 1949; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 20: 20. 1949, in Proc. 7th Pacific Sci. Congr. 5: 224-235. 1953; J. W. Parham in Dept. Agr. Fiji Bull. 30: 135. fig. 57. 1956, in op. cit. 35: 176. 1959, Pl. Fiji Isl. 312. 1964, ed. 2. 412. 1972; S. T. Blake in Proc. Roy. Soc. Queensland 80: 81. 1969.

Andropogon quadrivalvis L. in Murray, Syst. Veg. ed. 13. 758. 1774.

Annual, the culms 45-150 cm. high; leaf blades 10-30 cm. long, 5-6 mm. broad; panicle 10-30 cm. long, the leaflike spathes 1-3 cm. long, sparsely hairy along margins; spikelets about 5 mm. long, the awns 3-5 cm. long.

TYPEIFICATION: The original material presumably came from India.

DISTRIBUTION: Widespread in India. Greenwood first noted it in the vicinity of Lautoka in 1927 and considered that at that time it was a fairly recent introduction. It is now naturalized and moderately common, at least on Viti Levu, along roadsides and in waste places near sea level. Flowers have been noted between February and July.

LOCAL NAME AND USE: *Kangaroo grass*. It is considered of no economic value in Fiji but indeed is a weed.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Lautoka and vicinity, *Greenwood 137, DA 8223*; Vakambuli, near Lautoka, *DA 8240*; Votualevu, Nandi, *DA 10710*. SERUA: Navua, *DA 8999*. RA: Yanggara, *DA 7154, 7155, 7156, 7161, 8145*; Rakiraki, *DA 7941*. FIJI without further locality, *DA 3270, 3441, 3444, 3690*.

56. *DICHANTHIUM* Willemet in Usteri, *Neue Ann. Bot.* **18**: 11. 1796.

Annuals or perennials, the culms slender; panicle short, the racemes rare at base, exserted; spikelets sessile and stalked, awned.

TYPE SPECIES: *Dichanthium nodosum* Willemet, nom. superfl. (*Andropogon annulatus* Forssk.: *D. annulatum* (Forssk.) Stapf) (ING). This typification is complicated by the fact that Willemet, although including *Andropogon annulatus* in his synonymy, actually described *A. aristatus* Poir. The correct type species therefore is *D. aristatum* (Poir.) Hubbard, as discussed by Hubbard in *Kew Bull.* **1939**: 654. 1939, and by S. T. Blake in *Proc. Roy. Soc. Queensland* **80**: 65. 1969.

DISTRIBUTION: About 15 paleotropical species. Three species are naturalized in Fiji, and one of them, *Dichanthium caricosum*, covers large areas in the dry zones of Viti Levu and Vanua Levu. In the Fijian literature the generic name has often been misspelled as *Dicanthium*, a misspelling I have ignored in the following treatment.

KEY TO SPECIES

Racemes 1-3 together at apex of culm; sessile spikelets with broad, blunt, almost flat, shortly hairy lower glume.

Peduncle immediately below racemes glabrous; racemes usually 1, sometimes 2. 1. *D. caricosum*

Peduncle immediately below racemes densely pubescent; racemes 1-3, mostly 2. 2. *D. aristatum*

Racemes 3-7 or more; peduncle immediately below racemes glabrous; nodes densely pubescent.

3. *D. annulatum*

1. *Dichanthium caricosum* (L.) A. Camus in *Bull. Mus. Hist. Nat.* **27**: 549. 1921; Summerhayes & Hubbard in *Kew Bull.* **1927**: 29. 1927, in op. cit. **1930**: 255. 1930; B. E. V. Parham, *Fijian Pl. Names*, 54. 1942, in *Agr. J. Dept. Agr. Fiji* **16**: 105. 1945, in op. cit. **20**: 16. 1949, in *Proc. 7th Pacific Sci. Congr.* **5**: 230-239. fig. 7. 1953; Greenwood in *Proc. Linn. Soc.* **154**: 106. 1943, in *J. Arnold Arb.* **25**: 403. 1944; J. W. Parham in *Dept. Agr. Fiji Bull.* **30**: 125. fig. 52. pl. IX. 1956, in op. cit. **35**: 175. fig. 96. 1959, *Pl. Fiji Isl.* 303. 1964, ed. 2. 400. 1972.

Andropogon caricosus L. Sp. Pl. ed. 2. 2: 1480. 1763.

Perennial, the culms erect, 15-75 cm. high, from creeping base, the nodes usually glabrous; leaf blades 4-20 cm. long, 2.5-6 mm. broad; peduncle immediately below racemes glabrous; racemes 2.5-10 cm. long, the rachis many-jointed; spikelets paired, 4-5 mm. long, one sessile, one stalked, falling entire at maturity, 2-flowered, the sessile spikelet awned, the awn 1.2-2.5 cm. long.

TYPEIFICATION: Linnaeus's material was from India or an adjacent part of Asia.

DISTRIBUTION: Tropical Asia and Malesia. The species was introduced into Fiji in 1907 and now covers large areas from sea level to about 300 m., being very com-

mon especially in the dry zones, in pastures, canefields, waste places, and along roadsides. About 80 Fijian collections are available. Flowers have been recorded between February and November.

LOCAL NAMES AND USES: *Nandi blue grass*, *Nawai grass*, *Antigua hay grass*, *marvel lahan*, *marvel moth*i. It is an important pasture grass in the dry zone of Viti Levu, and in some dry areas it is also used as a lawn grass. Unfortunately it also becomes a weed of cultivation and waste places.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Near Lautoka golf course, *DA 8234*; Nalanggallangga, Nandi, *DA 15213*; Rambulu, *DA 15208*; Wairambatia, *DA 15210*; Wainimbothe, Nandarivatu road, *DA 8154*. NANDRONGA & NAVOSA: Near Momi lighthouse, *DA 8284*; Nasingga, *DA 15220*; Agricultural Station, Nathotholevu, Singatoka, *DA 12781*. SERUA: Navua, *DA 3257*. NAMOSI: Wainiuraura, *DA 8437*. RA: Ndombuilevu, *DA 7306*; Narewa, *DA 15205*. NAITASIRE: Vunindawa, *DA 11033*; Nanduruloulou, *DA 2521*. TAILEVU: Near Wainivesi turnoff, *DA 3036*; Tonia, Verata, *DA 7787*. REWA: Rodwell road, Suva, *DA 2905*. VANUA LEVU: MATHUATA: Lambasa, *Greenwood 594*; Tambuthola, *DA 8729*. THAKAUNDOVE: Marava Estate, *DA 8823*; Vunalangi, *DA 8949*.

2. *Dichanthium aristatum* (Poir.) Hubbard in Kew Bull. 1939: 654. 1939; J. W. Parham, Pl. Fiji Isl. 303. 1964, ed. 2. 400. 1972.

Andropogon aristatus Poir. in Lam. Encycl. Méth. Bot. Suppl. 1: 585. 1811.

Dichanthium nodosum Willemet in Usteri, Neue Ann. Bot. 18: 11, nom. superfl. 1796; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 16: 106. 1945, in op. cit. 20: 16. 1949, in Proc. 7th Pacific Sci. Congr. 5: 234-239. 1953; J. W. Parham in Agr. J. Dept. Agr. Fiji 19: 103. 1948, in Dept. Agr. Fiji Bull. 30: 125. fig. 53. 1956, in op. cit. 35: 175. 1959.

Andropogon nodosus sensu Greenwood in J. Arnold Arb. 36: 400. 1955; non Nash.

Perennial, the culms decumbent, becoming upright and 60-120 cm. high, the nodes moderately hairy; leaf blades 2-15 cm. long, 2.5-7.5 mm. broad; peduncle immediately below racemes densely pubescent; racemes 1-3, mostly 2, 2.5-10 cm. long; spikelets paired, falling entire at maturity, the sterile and fertile spikelets about 5 mm. long; awn 1.8-3.2 cm. long.

TIPIFICATION: The original material came from Mauritius and Africa.

DISTRIBUTION: India, but now introduced into Australia, Africa, and America. It is not known when this species was introduced into Fiji but in some areas, between sea level and 150 m., it is moderately common in association with *Dichanthium caricosum*, occurring on open hillsides, in canefields, and along roadsides. About 45 Fijian collections are at hand; flowers may be expected throughout the year.

LOCAL NAME: *Blue grass*. It is often confused with *Nandi blue grass* but is more fibrous and somewhat less common.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Lautoka, *Greenwood 1211, 1223*. NANDRONGA & NAVOSA: Agricultural Station, Nathotholevu, Singatoka, *DA 12782*. SERUA: Navua, *DA 9000*. RA: Yanggara, *DA 15207*; near Ellington, *DA 8073*; Vuakaindomu, *DA 15204*. NAITASIRE: Nasinu, *DA 2906*; Research Station, Koronivia, *DA 3958*. TAILEVU: Without locality, *DA 3033*. REWA: Nambua, near Suva, *DA 12619*; Pender Street, Suva, *DA 2887*. MAKONGAI: *DA 7957*.

3. *Dichanthium annulatum* (Forssk.) Stapf in Prain, Fl. Trop. Afr. 9: 178. 1917; Summerhayes & Hubbard in Kew Bull. 1927: 29. 1927, in op. cit. 1930: 255. 1930; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 16: 104. 1945, in op. cit. 20: 16. 1949, in Proc. 7th Pacific Sci. Congr. 5: 237, 239. 1953; J. W. Parham in Dept. Agr. Fiji Bull. 30: 128. fig. 54. 1956, Pl. Fiji Isl. 303. 1964, ed. 2. 400. 1972.

Andropogon annulatus Forssk. Fl. Aegypt.-Arab. 173. 1775; A. C. Sm. in Sargentia 1: 5. 1942.

Perennial, the culms densely tufted, ascending from decumbent base, 30-90 cm. high, the nodes usually densely pubescent; leaf blades 5-20 cm. long, 2.5-6 mm. broad; peduncle immediately below racemes glabrous; racemes 3-7 (usually 4-6), 2.5-7.5 cm. long; spikelets paired, overlapping, alike, sessile and stalked, 3-5 mm. long; awn 12-14 mm. long, fine.

TYPEIFICATION: The original material came from Egypt.

DISTRIBUTION: Southeastern Asia, tropical and northern Africa, Australia, and into the Pacific. It was first collected in Fiji in the 1920's by Greenwood, although now it is quite widespread. It occurs from sea level to about 150 m. on open hill-sides, seashores, in canefields, and along roadsides. I have examined about 35 Fijian collections. Flowers are noted throughout the year.

LOCAL NAME AND USE: *Vunda blue grass* (it being common on Vunda Point, Mba Province). It is reported to be a good pasture grass but apparently it is unable to compete with *Dichanthium caricosum*.

REPRESENTATIVE COLLECTIONS: VITI LEVU: Mba: Vunda Point, *DA 9732, 15211*; Saweni beach, *DA 9734*; Namulomulo road, Nandi, *DA 10285*. NANDRONGA & NAVOSA: Singatoka, *DA 3496*. NAITASIRI: Between Suva and Nasinu, *Gillespie 3163.9*; Plant Introduction and Quarantine Station, Nanduruloulou, *DA 7383*. REWA: Vicinity of Suva, *Degener & Ordenez 13512*; near Government Pharmacy, Suva, *DA 9106*; Walu Bay, Suva, *DA 2024*. VANUA LEVU: MATHUATA: Korowiri, *DA 8722*.

57. *BOTHRIOCHLOA* Kuntze, Rev. Gen. Pl. 2: 762. 1891.

Perennials, the culms sparingly branched; panicle lacking leaves; racemes several to many, the lower racemes on a short stalk, the rachis straight, the joints and pedicels flat.

TYPE SPECIES: *Bothriochloa anamitica* Kuntze (ING).

DISTRIBUTION: About 20 species are recognized in the warmer regions of the world. Five species, *Bothriochloa bladhii* (Retz.) S. T. Blake, *B. intermedia* (R. Br.) A. Camus, *B. pertusa* (L.) A. Camus, *B. ischaemum* (L.) Keng, and *B. glabra* (Roxb.) A. Camus (or their basionyms) have all, at various times, been recorded from Fiji. It now appears that *B. bladhii* is the only naturalized species and that *B. pertusa* and *B. glabra* should be referred to it as far as the Fijian collections are concerned. *Bothriochloa ischaemum* (cf. J. W. Parham in Fiji Dept. Agr. Bull. 30: 124. 1956, Pl. Fiji Isl. ed. 2. 396. 1972) was an introduction that did not survive beyond the initial trials and is no longer present in Fiji. It is, however, represented by the following collections from the Plant Introduction and Quarantine Station, Nanduruloulou, Naitasiri Province: *DA 7382, 7391, 8471, 8962, 9047, 9171, and 10138*.

1. *Bothriochloa bladhii* (Retz.) S. T. Blake in Proc. Roy. Soc. Queensland 80: 62. 1969; J. W. Parham, Pl. Fiji Isl. ed. 2. 396. 1972. FIGURE 80C & D.

Andropogon bladhii Retz. Obs. Bot. 2: 27. 1781.

Andropogon intermedius R. Br. Prodr. Fl. Nov. Holl. 202. 1810.

Amphilophis glabra sensu Summerhayes & Hubbard in Kew Bull. 1927: 29. 1927, in op. cit. 1930: 254. 1930; Greenwood in J. Arnold Arb. 25: 403. 1944; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 16: 106. 1945, in op. cit. 20: 15. 1949, in Proc. 7th Pacific Sci. Congr. 5: 233, 235. 1953; non Stapf.

Bothriochloa intermedia A. Camus in Ann. Soc. Linn. Lyon 11. 76: 164. 1931; J. W. Parham in Dept. Agr. Fiji Bull. 30: 124. 1956, Pl. Fiji Isl. 300. 1964.

Andropogon glaber sensu A. C. Sm. in Sargentia 1: 5. 1942; non Roxb.

Andropogon pertusus sensu Greenwood in J. Arnold Arb. 25: 403. 1944; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 16: 107. 1945, in op. cit. 20: 15. 1949, in Proc. 7th Pacific Sci. Congr. 5: 233. 1953; non Willd.

Bothriochloa glabra sensu J. W. Parham in Dept. Agr. Fiji Bull. 30: 123. 1956, Pl. Fiji Isl. 300. 1964, ed. 2. 396. 1972; non A. Camus.

Perennial, the culms glabrous, with well marked nodes, 30–90 cm. high; leaf blades flat or folded, glabrous, 15–37 cm. long, 5–10 mm. broad; panicle 7–15 cm. long, the axis smooth, the branches slender, whorled, 2.5–6 cm. long, the rachis joints pilose; sterile spikelet 2.5 mm. long, pilose on margins, the sessile spikelet shortly pilose near base, about 5 mm. long; fertile lemma bearing slender awn about 1 cm. long.



TIPIFICATION AND NOMENCLATURE: Only the epithets *bladhii* and *intermedia* are directly concerned in the above synonymy, the other names representing misidentifications. The type of *Andropogon bladhii* is a specimen from China collected by P. J. Bladh (holotype in the Retzius herbarium at the Botanical Museum in Lund). *Andropogon intermedius* is typified by *Brown (6184)* (BM HOLOTYPE), from Curtis Island, Queensland. The complex synonymy of this species was treated in detail by S. T. Blake in 1969.

DISTRIBUTION: Tropical Africa through India to China and Australia. The species was first recorded from Fiji by Greenwood in the 1920's and is now naturalized and moderately common (approximately 50 Fijian collections being available) between sea level and about 60 m. It occurs in the dry zones on open hillsides, in pastures and canefields, and along roadsides. Flowers have been observed throughout the year.

LOCAL NAMES AND USE: *Lautoka grass*, *Thamboni grass*, *native blue grass*. It is reported to be a good pasture grass but is hardly ever found in pure stands; it is also a weed of canefields and other cultivated areas.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Near Lautoka, *Greenwood 814*; near Nandi airport, *DA 8252*; Sambeto Valley, *DA 8266*; Korovou, east of Tavua, *Degener 14960*. NANDRONGA & NAVOSA: Momi hills, *DA 9061*; Agricultural Station, Nathotholevu, Singatoka, *DA 12584*. RA: Public Works Dept. yard, Penang, *DA 3029*; Thamboni, *DA 8116*. NAITASIRE: Nasinu Training College Farm, *DA 9362*; Research Station, Koronivia, *DA 3950*; Plant Introduction and Quarantine Station, Nanduruloulou, *DA 10134*. TAILEVU: Queen Victoria School, Matavatathou, *DA 7747*. REWA: Department of Agriculture, Suva, *DA 9122*. VANUA LEVU: THAKAUNDROVE: Savusavu airport, *DA 14305*, p. p. VANUA MBA-LAVU: *DA L.11008*. Summerhayes and Hubbard report Tothill collections from these additional islands: Mbatiki, Nairai, Ngau, Totoya, Matuku, Kanathea, Nayau, and Lakemba.

58. ZEA L. Sp. Pl. 971. 1753, Gen. Pl. ed. 5. 419. 1754; Seem. Fl. Vit. 327. 1873.

Annual, the culms robust; panicles terminal, composed of "tassels" of ♂ racemes, and axillary, ♀, short-stalked, many-nerved spikelets ("ears") enclosed in spathes ("husks"); spikelets unisexual; ♂ spikelets 2-flowered, paired, on one side of a continuous rachis, one almost sessile, the other stalked; ♀ spikelets sessile, paired, made up of one fertile and one sterile floret, the latter occasionally developed as a second fertile floret.

TYPE SPECIES: *Zea mays* L., the only species included by Linnaeus (ING).

DISTRIBUTION: One species, *Zea mays* L., originally from tropical America and now widely cultivated throughout the warmer regions of the world. In Fiji it was an early European introduction.

1. *Zea mays* L. Sp. Pl. 971. 1753; Seem. Viti, 444. 1862, Fl. Vit. 327. 1873; Summerhayes & Hubbard in Kew Bull. 1927: 25. 1927; B.E.V. Parham, Fijian Pl. Names, 54. 1942, in Agr. J. Dept. Agr. Fiji 20: 20. 1949; J.W. Parham in Dept. Agr. Fiji Bull. 30: 142. 1956, Pl. Fiji Isl. 312. 1964, ed. 2. 413. 1972.

Culms 2-4.8 m. high; sheaths overlapping, the leaf blades broad, 90 cm. or more long, about 10 cm. broad; ♂ spikelets borne in large, spreading, terminal panicles; ♀ spikelets borne in leaf axils on thickened, almost woody axis ("cob"), enclosed in a number of leaflike bracts or spathes, with very long, silky styles protruding from top as a mass of silky threads; mature grains much larger than glumes.

TIPIFICATION: After giving several prior references, Linnaeus stated: "*Habitat in America.*"

FIGURE 80. A & B, *Microstegium glabratum*, from *DA 1220*; A, inflorescence, × 1; B, portion of inflorescence, × 8. C & D, *Bothriochloa bladhii*, from *DA 12584*; C, inflorescence, × 1; D, portion of inflorescence, × 8.

DISTRIBUTION: The precise date of this early European introduction into Fiji cannot be stated, but the species is now commonly cultivated.

LOCAL NAMES AND USES: *Maize*, *Indian corn*, *sweet corn*, *corn*, *sila ni vavalangi* (i.e. the foreign *sila*), *makai* (Hindi). Some of the varieties commonly grown in Fiji were briefly mentioned by me in 1956. *Zea mays* is very susceptible to downy mildew disease (*Sclerospora sacchari*), which can be transmitted to sugarcane. Sugarcane farmers have been encouraged to grow *Sorghum vulgare* as a substitute, and introductions of high lysine, rust-resistant varieties of *Z. mays* are also being tried.

As might have been anticipated, plant collectors in Fiji seem not to have bothered preparing herbarium vouchers for this species. The extensive and brilliant research that has been conducted in regard to the origin of *maize* and its relationship to other grasses is well summarized by J. W. Purseglove, *Tropical Crops: Monocotyledons*, 298–334. 1972.

59. COIX L. Sp. Pl. 972. 1753, Gen. Pl. ed. 5. 419. 1754; Seem. Fl. Vit. 326. 1873.

Annual, the culms robust; leaves broad; spikelets unisexual, 2 or 3 ♀ spikelets together, one fertile, one or two rudimentary, enclosed in a bony beadlike “involucre” (or hard, subtending leaf sheath); ♂ spikelets usually in threes (the third sometimes absent), on a slender rachis forming a short raceme.

LECTOTYPE SPECIES: *Coix lacryma-jobi* L. (ING).

DISTRIBUTION: Five species are usually recognized, mostly occurring in tropical Asia. The only species known from Fiji, *Coix lacryma-jobi*, is presumed to be an aboriginal introduction.

1. *Coix lacryma-jobi* L. Sp. Pl. 972. 1753; Summerhayes & Hubbard in Kew Bull. 1927: 25. 1927, in op. cit. 1930: 253. 1930; B. E. V. Parham, Fijian Pl. Names, 54. 1942, in Agr. J. Dept. Agr. Fiji 13: 44. 1942, in op. cit. 20: 16. 1949; J. W. Parham in Dept. Agr. Fiji Bull. 30: 143. fig. 61. 1956, in op. cit. 35: 177. 1959, Pl. Fiji Isl. 302. 1964, ed. 2. 399. 1972.

Coix lacryma L. Syst. Nat. ed. 10. 1261. 1759; Seem. in Bonplandia 9: 261. 1861, Viti, 444. 1862, Fl. Vit. 326. 1873; C. H. Wright in Dept. Agr. Fiji Bull. 10: 7. 1918.

Annual, the culms 50–150 cm. high; leaf blades glabrous, 10–45 cm. long, 1.2–5 cm. broad; inflorescence 1.2–3.7 cm. long, the spikelets 6–10 mm. long, in groups of 2 or 3, one sessile, the remainder stalked, on a slender rachis protruding from shiny, white or blue-gray-tinged, globose or ovoid, beadlike sheath (or “involucre”) 10–12 mm. long, this enclosing ♀ spikelet.

TYPEIFICATION: Linnaeus gave several prior references and then indicated: “*Habitat in Indiis.*”

DISTRIBUTION: Cultivated in many parts of the tropics as a cereal. In Fiji it is moderately common, doubtless more so than the cited collections suggest, from sea level to about 900 m. It occurs in damp places, along edges of streams, crest clearings, waste places, and along roadsides. Flowers and fruit have been noted between May and November.

LOCAL NAMES AND USE: *Job's tears*, *sila*. In some parts of the Asian tropics the species is utilized for food or medicine, but in Fiji the “involucres” are used for making beads which are commonly on sale to tourists in the local markets.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Northern portion of Mt. Evans Range, between Mt. Vatuyanitu and Mt. Natondra, *Smith* 4289; Nandarivatu, *Gillespie* 4308, *DA* 9725; base of Mt. Tomanivi, *DA* 13017. RA: Mborotu, *DA* 7880, 9508; Rewasa, *DA* 8092. NAITASIRE: Nawanggambena, *DA* 731. TAILEVU: Between Ndaku and Mburetu, *DA* 882; vicinity of Korovou, *DA* 3524, 8462, 10492; near Nau-

sori, *Parks 20240*. REWA: Suva, *DA L.12541*. VANUA LEVU: MATHUATA: Nanduri, *Tothill F.428*; Ndravuninggatandamu, *DA 3500*. FIJI without definite locality, *Home, Seemann 692*. Additionally, Summerhayes and Hubbard record collections from the islands of Ovalau, Ngau, Taveuni, Moala, Matuku, and Vanua Mbalavu.

60. *TRIPSACUM* L. Syst. Nat. ed. 10. 1261. 1759.

Perennials, the culms robust; leaf blades flat, broad; inflorescence terminal, axillary, monoecious, of 1-3 spikes, the ♀ part below, breaking up into hard, seedlike joints, the ♂ part above on same rachis, falling as a whole; spikelets unisexual; ♂ spikelets 2-flowered, paired, one sessile, one stalked on one side of continuous rachis; ♀ spikelets solitary, on opposite sides of same rachis, sunken in hollows, made up of one perfect floret and one sterile lemma.

LECTOTYPE SPECIES: *Tripsacum dactyloides* (L.) L. (*Coix dactyloides* L.) (ING).

DISTRIBUTION: Seven species are frequently recognized, occurring in tropical and subtropical America. Two species have been recorded from Fiji, *Tripsacum laxum*, which is established in a number of areas, and *T. dactyloides* (L.) L., which was introduced as a fodder about 1949 but which has not persisted; no herbarium vouchers are available even from trial plots (cf. J. W. Parham in Fiji Dept. Agr. Bull. 30: 144. 1956).

1. *Tripsacum laxum* Nash in N. Amer. Fl. 17: 81. 1909; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 20: 20. 1949, in Proc. 7th Pacific Sci. Congr. 5: 239. fig. 8. 1953; J. W. Parham in Dept. Agr. Fiji Bull. 30: 145. pl. XII. 1956, Pl. Fiji Isl. 312. 1964, ed. 2. 412. 1972.

Perennial, the culms stout, 3-3.6 m. high, the nodes black, prominent; leaf blades 45-60 cm. long, 7.5-10 cm. broad, the margins scabrous; inflorescence 22-30 cm. long, the spikes fascicled; spikelets 6-9 mm. long, lacking an awn.

TIPIFICATION: The original material came from Mexico.

DISTRIBUTION: Mexico, but now widespread as a fodder grass. It was introduced into Fiji from Trinidad in 1945 and has been distributed for use, persisting in various areas although herbarium vouchers are available only from a trial plot. Flowers have been noted in May.

LOCAL NAME AND USE: *Guatemala grass*. It is considered a useful fodder grass.

AVAILABLE COLLECTIONS: VITI LEVU: NAITASIRE: Plant Introduction and Quarantine Station, Nanduruloulou, *DA 5594, 9120*.

ERRONEOUSLY REPORTED SPECIES

Olyra micrantha H. B. K. Nova Gen. et Sp. 1: 199. 1816; Seem. Fl. Vit. 326. 1873; Summerhayes & Hubbard in Kew Bull. 1927: 44. 1927.

Seemann recorded a *U. S. Expl. Exped.* specimen from Mbua Bay, Mbua Province, Vanua Levu, as representing this species. Summerhayes and Hubbard were of the opinion that the Fijian record is erroneous and that the specimen in question may have come from South America; mixtures in the labelling of the Exploring Expedition material were unfortunately frequent.

UNESTABLISHED SPECIES

In the preceding treatment of Poaceae I have frequently indicated, in discussing the appropriate genera, certain species that were introduced into Fiji for trial but did not become naturalized, nor are they currently believed to be in cultivation. There remain several species of this category belonging to genera not treated above. In

order to complete mention of grasses that have been brought into Fiji for trial, these species are now briefly discussed.

***Bouteloua curtipendula* (Michx.) Torr.**

The *sides oat grama* has been grown at the Plant Introduction and Quarantine Station, Nanduruloulou, from *FDA 13887*. Herbarium vouchers exist as *DA 7388*, *7393*, *8329*, *8331*, and *9041*. Apparently not now in cultivation or naturalized in Fiji (cf. J. W. Parham in Dept. Agr. Fiji Bull. **30**: 41. 1956, Pl. Fiji Isl. ed. 2. 396. 1972).

***Bromus catharticus* Vahl**

The *rescue grass* was introduced into Fiji for trial in 1950 (as *FDA 13373*) but has failed to persist. It was grown at the Plant Introduction and Quarantine Station, Nanduruloulou, and at the Research Station, Koronivia. Herbarium vouchers are *DA 3588-3599*, *3605-3609*, *3613*, *3614*, *3635*, *7460*, and *7461*. (Cf. J. W. Parham in Dept. Agr. Fiji Bull. **30**: 22. 1956, Pl. Fiji Isl. ed. 2. 397. 1972.)

***Cynosurus cristatus* L.**

The European *crested dog's tail* was introduced into Fiji for trial but failed to become established. No herbarium vouchers are available (cf. J. W. Parham in Dept. Agr. Fiji Bull. **30**: 31. 1956). The record is probably based on B. E. V. Parham in Agr. J. Dept. Agr. Fiji **20**: 16. 1949.

***Euchlaena mexicana* Schrader**

The *teosinte* was introduced into Fiji for trial as a fodder crop in 1909, 1920, and 1954, but it probably has not persisted, although occasional cultivated specimens may possibly still exist. No herbarium vouchers support the record (cf. B. E. V. Parham in Agr. J. Dept. Agr. Fiji **20**: 17. 1949; J. W. Parham in Dept. Agr. Fiji Bull. **30**: 142. 1956).

***Gastridium ventricosum* (Gouan) Schinz & Thell.**

The European *nit grass* has been mentioned as occurring in Fiji as a weed, but no herbarium vouchers support this statement, and probably it has either failed to persist or the identification was erroneous (cf. B. E. V. Parham in Agr. J. Dept. Agr. Fiji **20**: 17. 1949; J. W. Parham in Dept. Agr. Fiji Bull. **30**: 48. 1956).

***Gynerium sagittatum* (Aubl.) Beauv.**

The *wild cane* or *ngasau ni valalangi* was reported as occurring in various parts of Fiji, but no herbarium vouchers support the record. The Fijian local name suggests that the report may actually refer to *Arundo donax*. Cf. B. E. V. Parham in Agr. J. Dept. Agr. Fiji **20**: 17. 1949; J. W. Parham in Dept. Agr. Fiji Bull. **30**: 25. 1956.

***Ixophorus unisetus* Schlechtendal**

This grass was introduced for trial in 1957 but has not become established as far as known. Herbarium vouchers from the Research Station at Nathotholevu, Singatoka, are *DA 11309*, *11701*, and *12585*. Cf. J. W. Parham, Pl. Fiji Isl. ed. 2. 405. 1972.

***Lolium multiflorum* Lam.**

The *Italian ryegrass* was introduced into Fiji in 1933, but it failed to persist in trial plots at Nanduruloulou; no herbarium vouchers are available. Cf. B. E. V. Parham in Agr. J. Dept. Agr. Fiji **20**: 17. 1949; J. W. Parham in Dept. Agr. Fiji Bull. **30**: 24. 1956.

***Lolium perenne* L.**

The *perennial ryegrass* or *English ryegrass* was introduced into Fiji in 1934 and grown in trial plots at Navuso, Naitasiri Province; however, it did not become established and the record is not supported by herbarium vouchers. Cf. B. E. V. Parham in Agr. J. Dept. Agr. Fiji **20**: 17, 1949; J. W. Parham in Dept. Agr. Fiji Bull. **30**: 24, 1956.

***Phalaris canariensis* L.**

This species was introduced for trial but failed to become established. A supporting herbarium voucher is DA 5598, from the Department of Agriculture in Suva, previously reported (B. E. V. Parham in Agr. J. Dept. Agr. Fiji **20**: 19, 1949; J. W. Parham in Dept. Agr. Fiji Bull. **30**: 49, 1956) as *Phalaris tuberosa* L.

***Phleum pratense* L.**

Although no herbarium vouchers support the presence of the *timothy* in Fiji, the species has been reported to occur rarely, but the identification cannot be verified (cf. J. W. Parham in Dept. Agr. Fiji Bull. **30**: 48, 1956).

***Sorghastrum nutans* (L.) Nash**

The *Indian grass* was introduced into Fiji from Texas in 1953 (*FDA 13898*) but has not persisted. Herbarium vouchers from the Plant Introduction and Quarantine Station at Nanduruloulou are DA 7386 and 8328 (cf. J. W. Parham in Dept. Agr. Fiji Bull. **30**: 119, 1956).

***Spartina townsendii* H. & J. Groves**

This grass, of potential value in retarding water flow, was introduced into Fiji in 1933 for trial in areas in Rewa Province, Viti Levu, but it did not become established. There are no Fijian herbarium vouchers (cf. H. R. Surridge in Agr. J. Dept. Agr. Fiji **8** (3): 22, 1937; J. W. Parham in Dept. Agr. Fiji Bull. **30**: 35, 1956).

***Urochloa mosambicensis* (Hackel) Dandy**

Sometimes referred to *Urochloa pullulans* var. *mosambicensis* Stapf, this species was introduced into Fiji in 1950 for trial as a fodder and pasture grass, but apparently it has not persisted in cultivation or become naturalized. Several herbarium vouchers are available from the Agricultural Station, Nathotholevu, Singatoka, and the Plant Introduction and Quarantine Station, Nanduruloulou: DA 3833, 8472, 8573, 8979, 10141, 10844, and 14753. Cf. J. W. Parham in Dept. Agr. Fiji Bull. **30**: 71, 1956, Pl. Fiji Isl. ed. 2, 413, 1972.

SUBCLASS ARECIDAE

KEY TO ORDERS OCCURRING IN FIJI

- Flowers well developed but usually small, with an obvious, biseriate perianth, each perianth series usually of 3 members; gynoeceum superior, with 1-3 separate carpels or 3 (-10) united carpels; usually trees with unbranched trunks and a terminal crown of large leaves, the stems solitary or caespitose, sometimes climbing and with scattered leaves; leaf sheaths tubular, the blade usually pinnately or palmately compound, with segments plicate between veins; inflorescence more or less branched, subtended by a large spathe. ARECALES (FAMILY 39)
- Flowers more or less reduced and often crowded into a spadix; perianth none or with 4-6 free or united tepals or simulated by threadlike or scalelike organs; carpels united in a compound ovary, this sometimes 1-locular; herbs, climbers, or trees (but if arborescent then without a terminal crown of broad leaves); leaf blades not plicate.

Herbs, erect or floating or submerged, rarely climbing and somewhat woody; leaves radical or cauline (or in Lemnaceae functionally replaced by free-floating, thalloid fronds), simple to variously compound, often with an expanded, net-veined blade; inflorescence a spike of small, sessile flowers subtended by a large bract (or in Lemnaceae with or without a membranous, caducous sheath); flowers bisexual or unisexual; stamens usually 1-6. ARALES (FAMILIES 40, 41)

Herbs or trees or shrubs, sometimes climbing; leaves elongate and proportionately narrow, sheathing at base; flowers unisexual.

Diocious trees or shrubs, sometimes climbing; leaves usually spirally arranged, coriaceous, usually spiny on margins and keel; inflorescence usually a racemose spadix at first enclosed by spatheaceous bracts, these sometimes colored or leaflike; flowers without a perianth; ♂ flowers with numerous stamens variously arranged on a spadix; ♀ flowers congested, the ovaries with 1-many ovules; fruit a syncarp composed of densely crowded drupes or berries.

PANDANALES (FAMILY 42)

Monocious, rhizomatous, aquatic or marsh herbs; leaves biseriate, not spiny; flowers crowded in dense, cylindrical spikes or in separate globose clusters, the ♂ above the ♀; flowers accompanied by threadlike or scalelike organs simulating a perianth; ♂ flowers with 2-7 stamens; ♀ flowers with a 1-locular ovary, the ovule solitary, pendulous; fruit small, dehiscent or indehiscent. TYPHALES (FAMILY 43)

ORDER ARECALES

FAMILY 39. ARECACEAE

BY HAROLD E. MOORE, JR.

(L. H. Bailey Hortorium, Cornell University)

ARECACEAE C. H. Schultz-Schultzenstein, Nat. Syst. Pflanzenr. 317. 1832.

Palmae Juss. Gen. Pl. 37. 1789. Nom. alt.

Stems "woody," slender to very stout, prostrate to erect or climbing, solitary or caespitose, sometimes spiny, rarely branched; leaves alternate, sometimes spiny, caducous or marcescent; sheaths tubular and forming a prominent crownshaft or split opposite the petiole and sometimes also basally beneath the petiole; petiole evident or lacking; blade induplicate or reduplicate palmate, costapalmate, pinnate, pinnately ribbed, or bipinnate, the rachis sometimes continued in a spiny cirrus; inflorescence infrafoliar, interfoliar, or compound and suprafoliar and then terminating the life of the shoot, sometimes spiny, spicate or paniculately or digitately branched, sometimes modified into a spiny flagellum; peduncles solitary or rarely several in a leaf axil, bearing an ancipitous prophyll and usually 1 or more peduncular bracts; branches, rachillae, and flower clusters usually subtended by a bract; flowers usually bracteolate, bisexual or unisexual, actinomorphic, borne singly, or in adnate cincinni, or in pairs of staminate, neuter, pistillate, and hermaphroditic in various combinations, or in triads of 2 staminate and a pistillate; sepals (2 or) 3 or rarely more, distinct and imbricate or connate; petals (2 or) 3 or rarely more, in hermaphroditic or pistillate flowers mostly distinct and imbricate, sometimes with briefly valvate apices, more rarely briefly to markedly connate, in staminate flowers valvate or rarely connate; stamens (3-) 6-many, reduced to staminodes or a staminodial cupule or lacking in pistillate flowers, the filaments distinct or variously connate and/or adnate to petals, erect or inflexed at apex in bud, the anthers basifixed, dorsifixed, or rarely didymous, latrorsely dehiscent; gynoecium superior, apocarpous with 1-3 distinct carpels, or syncarpous with 3 (-10) locules, or pseudomonomerous, reduced or lacking in staminate flowers, the style often not evident, the stigmas usually recurved; ovule normally 1 per locule, anatropous to orthotropous, basally, laterally, or apically attached; fruit smooth, scaly, or tuberculate; mesocarp fleshy or fibrous; endocarp thin and fragile to bony, sometimes with an operculum over the embryo or with 3 (-7) pores; seeds 1 or sometimes 2-10; endosperm homogeneous or ruminant; embryo basal, lateral, or apical.

DISTRIBUTION: A large, primarily pantropical and subtropical family of about 210 genera and nearly 2,800 species, the Arecaceae include many species of economic or ornamental importance. In Fiji, 28 genera and 45 or 46 species are recorded, of which ten genera and 21 or 22 species are indigenous. Seventeen genera and 23 species have been introduced as ornamental or economic plants, while the monotypic *Cocos* may or may not be truly indigenous. *Balaka*, with five species, and *Veitchia*, with about five or six species, are the largest indigenous genera. All indigenous Fijian species are endemic, but the only endemic genera are *Neoveitchia* and *Goniocladus*, the latter inadequately known and questionable.

USEFUL TREATMENTS OF FAMILY: Hooker, J. D. *Palmae*. Benth. & Hook. f. *Gen. Pl.* 3: 870-948. 1883. Drude, O. *Palmae*. Engl. & Prantl, *Nat. Pflanzenfam.* II. 3: 1-93. 1887. Beccari, O., & R. E. G. Pichi-Sermolli. *Subfamiliae Arecoidaeum palmae gerontogaeae tribuum et generum conspectus*. Webbia 11: 1-187. 1955. Moore, H. E., Jr. The major groups of palms and their distribution. *Gentes Herb.* 11: 27-141. 1973.

KEY TO GENERA

Leaf blades palmate or costapalmate.

Flowers bisexual (or if rarely unisexual then not markedly dimorphic), sessile or pedicellate, never sunken in pits (CORYPHOIDEAE).

Carpels connate by their styles only; inflorescence interfoliar; pleoanthic palms.

Petals not circumscissile; inflorescence with primary branches borne along the main axis; petiole usually spinose-toothed along the margin, at least basally.

Leaf blades with segments all 1-ribbed and bifid; stamen filaments not connate in a tube.

1. *Livistona*

Leaf blades with several-ribbed segments or undivided and orbicular, toothed distally; stamen filaments usually connate in a tube. 2. *Licuala*

Petals forming a circumscissile cap above the soft connate base; inflorescence of one or several long-pedunculate axes from a prophyll in the leaf axil, each terminated by a short panicle; petiole not toothed. 3. *Pritchardia*

Carpels connate throughout at anthesis; inflorescence suprafoliar, compound; hapaxanthic palms.

4. *Corypha*

Flowers unisexual, markedly dimorphic, the staminate solitary and sunken in pits in thickened axes, the pistillate large, sessile, borne singly along the axes; plants dioecious (BORASSOIDEAE).

6. *Latania*

Leaf blades pinnately ribbed, pinnate, or bipinnate.

Lower pinnae modified into stout spines; inflorescence with flattened peduncles bearing a prophyll and no peduncular bract (PHOENICOIDEAE). 5. *Phoenix*

Lower pinnae not modified into spines; inflorescences various.

Ovary and fruit covered with imbricate scales (LEPIDOCARYOIDEAE).

Monoecious, arborescent palms; staminate and pistillate (or hermaphroditic) flowers borne on the same rachilla or in the same axil; leaves not terminating in a cirrus.

Ultimate rachillae thick, amentiform, bearing 2 externally similar flowers in the axil of each bract on the rachilla; seed with endosperm homogeneous, though often excavate.

7. *Metroxylon*

Ultimate rachillae flattened, bearing solitary pistillate flowers at each node in the lower part and dissimilar staminate flowers in the upper part; seed with ruminant endosperm.

8. *Raphia*

Dioecious lianas; flowers borne solitary (staminate) or in pairs in the axil of each bract on the slender rachilla; leaves terminating in a cirrus with hooked claws on lower surface.

9. *Calamus*

Ovary and fruit not covered with imbricate scales.

Inflorescences (with rare exceptions) produced basipetally, bearing a prophyll and several peduncular bracts on the peduncle; pinnae induplicate at insertion on the rachis (CARYOTOIDEAE).

Leaves pinnate. 10. *Arenga*

Leaves bipinnate. 11. *Caryota*

Inflorescences produced acropetally, bearing a prophyll and usually one peduncular bract on the peduncle; pinnae reduplicate at insertion on the rachis.

- Fruit with a thin and sometimes operculate or rarely thick endocarp, but then the endocarp lacking 3 pores (ARECOIDEAE).*
- Petals of pistillate flowers connate basally, valvate above; staminodes connate in a lobed cupule adnate basally to petals. 12. *Roystonea*
- Petals of pistillate flowers distinct and imbricate basally; staminodes distinct or lacking.
- Endocarp lacking a distinct operculum over the embryo; mesocarp usually prominently fibrous.
- Stigmatic residue basal in fruit; stamen filaments inflexed at apex in bud. 13. *Chrysalidocarpus*
- Stigmatic residue apical or nearly so in fruit; stamen filaments erect in bud.
- Inflorescence bearing both a prophyll and a peduncular bract on peduncle; pistillate flowers equal to or smaller than staminate.
- Staminate flowers asymmetrical; pinnae 1-ribbed, acute. 14. *Archontophoenix*
- Staminate flowers more or less symmetrical, with rounded, navicular petals and broadly imbricate, rounded sepals; pinnae 1-ribbed, cuneate or with nearly parallel sides but the apex erose-truncate or erose-oblique.
- Seed terete in cross section. 15. *Veitchia*
- Seed angled or sulcate in cross section.
- Seed angled in cross section, acute; fruit often angled and tapered to both ends; peduncle elongate, with peduncular bract inserted well above and exerted from prophyll. 16. *Balaka*
- Seed 3-5-sulcate in cross section; peduncle short, with peduncular bract inserted close to and included within prophyll. 17. *Ptychosperma*
- Inflorescence bearing only a prophyll on peduncle, peduncular bract not developed; pinnae mostly several-ribbed with acute or toothed apex.
- Inflorescence 2-3-times branched; pistillate flowers larger than staminate; triads secund at or near base and staminate flowers uniseriately distichous distally; fruit 4-5 cm. long. 18. *Areca*
- Inflorescence simply branched; pistillate flowers smaller than staminate; triads distichous; fruit 10-14 mm. long. 19. *Pinanga*
- Endocarp with a distinct operculum over the embryo; stamen filaments inflexed at apex in bud.
- Rachillae with 3-7 triads of 2 staminate and a pistillate flower near base, and with only staminate flowers distally, these in vertically oriented pairs sunken in distinct depressions; fruit 4.5-5 cm. long, smooth. 20. *Neoveitchia*
- Rachillae with triads of 2 staminate and a pistillate flower basally or nearly throughout, and with staminate flowers distally in horizontally oriented pairs or solitary; fruit less than 4 cm. long or covered with wartlike protuberances.
- Prophyll completely encircling the peduncle at insertion; seed terete in cross section.
- Fruit more than 2.5 cm. in diameter, covered with prominent, corky, wartlike tubercles; stigmatic residue basal; leaves pinnately ribbed and undivided; inflorescences interfoliar. 21. *Pelagodoxa*
- Fruit less than 2.5 cm. in diameter, smooth; leaves pinnate; inflorescences infrafoliar.
- Fruit with stigmatic residue apical; seed with ruminate endosperm; stilt roots not developed. 22. *Dictyosperma*
- Fruit with stigmatic residue excentrically apical or lateral to basal; seed with homogeneous endosperm; stilt roots developed. 23. *Clinostigma*
- Prophyll incompletely encircling the peduncle at insertion, the margins separated abaxially; seed angled or ridged in cross section.
- Leaf sheaths split opposite petiole, not forming a prominent crownshaft; inflorescence long-pedunculate, stiffly and divaricately branched, the branches prominently pulvinate at base; fruit drying with a "pebbled" surface. 24. *Cyphosperma*
- Leaf sheaths tubular, forming a prominent crownshaft; inflorescence infrafoliar, short-pedunculate, the branches not prominently pulvinate at base; fruit not "pebbled" when dry. 25. *Physokentia*

* Genus 26, *Goniocladus*, belongs here but is not keyed further owing to lack of information.

Fruit with a bony, 3 (-7)-pored endocarp (COCOSOIDEAE).

Pistillate flowers not sunken in the inflorescence axes; flowers of both sexes normally on the same inflorescence; endocarp with pores near base; peduncular bract woody; fruit large, more than 15 cm. long. 27. *Cocos*

Pistillate flowers deeply sunken in the inflorescence axes; inflorescences normally unisexual; endocarp with pores above middle; peduncular bract fibrous; fruit small, less than 5 cm. long. 28. *Elaeis*

1. LIVISTONA R. Br. Prodr. Fl. Nov. Holl. 267. 1810; H. E. Moore & Fosberg in Gentes Herb. 8: 432. 1956; H. E. Moore in op. cit. 9: 266. 1963.

Solitary, erect, pleonanthic, hermaphroditic (or rarely dioecious) palms; leaf blades costapalmate; segments 1-ribbed, acutely bifid, induplicate at insertion; petiole usually spinose-toothed along margins, at least basally; inflorescences interfoliar, with several branches along axis, each branch subtended by a tubular bract and again branched one or more times; flowers usually bisexual, borne singly or in sessile or stalked cincinni along rachillae; sepals connate in a 3-lobed calyx; petals 3, connate basally, valvate above; stamens 6; carpels 3, connate by their styles only; fruit globose to ellipsoid or subreniform, 1-seeded; seed with homogeneous endosperm intruded by testa below raphe; embryo lateral.

LECTOTYPE SPECIES: *Livistona humilis* R. Br. (vide H. E. Moore in Gentes Herb. 9: 266. 1963), one of the two species originally included by Brown.

DISTRIBUTION: Old World tropics from India to the Philippine Islands, Australia, and the Solomon Islands. About 28 species, of which several are widely cultivated, two in Fiji.

USEFUL TREATMENT OF GENUS: Beccari in Ann. Bot. Gard. Calcutta 13: 43. 1933.

KEY TO SPECIES

- Flowers about 5 in a cincinnus; calyx lobes more or less rounded and prominently nerved; fruit blue-green, ellipsoid to subglobose, 15-26 mm. long, 9-19 mm. in diameter. 1. *L. chinensis*
Flowers mostly paired, one nearly sessile, the other often short-pedicellate; calyx lobes acute and nerves not evident; fruit blue-black, globose, 16-18 (-20) mm. in diameter. 2. *L. australis*

1. *Livistona chinensis* (Jacq.) R. Br. ex Mart. Hist. Nat. Palm. 3: 240. *t.* 136, *fig.* 1-3. 1838; Becc. in Ann. Bot. Gard. Calcutta 13: 59. 1933; J. W. Parham in Agr. J. Dept. Agr. Fiji 19: 93. 1948; H. E. Moore & Fosberg in Gentes Herb. 8: 433. *fig.* 130. 1956; J. W. Parham, Pl. Fiji Isl. 275. 1964, ed. 2. 371. 1972.

Latania chinensis Jacq. Fragm. Bot. 16. *t.* 11, *fig.* 1. 1801.

Trunk to 15 m. high or more; leaf blades light green; segments deeply bifid with pendulous tips; inflorescence large, with brown, tomentose bracts; flowers yellow-green, as are rachillae in fruit. Three varieties have been recognized, based largely on fruit shape and size (cf. H. E. Moore & Fosberg, 1956, cited above): var. *chinensis*, with ellipsoid, blue-green fruit 15-20 mm. long and 9-11 mm. in diameter, is the one usually seen in cultivation. It is grown in Suva and doubtless elsewhere in Fiji.

TYPIFICATION: In the apparent absence of specimen material, the species may be typified by the original description and accompanying figure. Jacquin based these on a plant cultivated in a greenhouse at "horti Schönbrunnensis," the material having come from Mauritius but said to have been of Chinese origin.

DISTRIBUTION: Ryukyu Islands, Bonin Islands, Volcano Islands, and islands off Kyushu, Japan. Beccari suggested that the species might be native in the southern provinces of China, but no material of undoubted nativity has been seen from continental Asia. It is now widely cultivated in the tropics of both hemispheres. No Fijian vouchers have been seen, but the record indicated by Parham is doubtless correct.

LOCAL NAME AND USES: *Chinese fan palm*; this name is recorded by Parham, who states that the species was introduced into Fiji in the 1880's and is commonly grown as an ornamental. The leaves are sometimes used for hats and thatch in Malesia.

2. *Livistona australis* (R. Br.) Mart. Hist. Nat. Palm. 3: 241. 1838; Becc. in Ann. Bot. Gard. Calcutta 13: 79. 1933; J. W. Parham in Agr. J. Dept. Agr. Fiji 19: 93. 1948, in op. cit. 29: 33. 1959, Pl. Fiji Isl. 275. 1964, ed. 2. 371. 1972.

Corypha australis R. Br. Prodr. Fl. Nov. Holl. 267. 1810.

Resembles *Livistona chinensis* in aspect, but is distinguished by the arrangement of flowers and the color of mature fruit.

TYPEFICATION: The holotype is *R. Brown s. n.* (BM) from near Port Jackson, Australia.

DISTRIBUTION: Southeastern Australia, in New South Wales and Queensland; occasionally cultivated elsewhere.

LOCAL NAME AND USES: *Australian fan palm*; this is the name recorded by Parham, who indicates that the species was introduced in the 1880's and is now moderately commonly grown as an ornamental, attaining a height of 24 m. It is widely used in Australia, the leaves for baskets and hats, the trunks for construction, and the heart as food.

As no voucher material is available from Fiji, it is not certain that all material cultivated there as *Livistona australis* is correctly identified, but the identity given by Parham is very likely to be correct.

2. *LICUALA* Thunb. in Kongl. Vetensk. Acad. Nya Handl. 3: 286. 1782.

Solitary, caespitose, or "acaulescent," pleoanthic, hermaphroditic palms; leaf blades costapalmate with usually 2-several-ribbed, truncate, apically toothed segments induplicate at insertion or the blade undivided and toothed along margin; petiole usually spinose-toothed along margins, at least basally; inflorescence interfoliar, with several branches along axis to rarely spicate, each branch subtended by a tubular bract and often again branched; flowers usually bisexual, borne singly or in sessile or stalked cincinni along rachillae; sepals connate in a tubular, usually 3-lobed calyx; petals 3, connate basally, valvate above; stamens 6, the filaments usually connate in a 3- or 6-lobed tube more or less projecting from throat, rarely distinct; carpels 3, connate by their styles only; fruit globose to ellipsoid, 1-seeded; seed with homogeneous endosperm intruded by the testa below raphe, sometimes subruminate; embryo lateral.

TYPE SPECIES: *Licuala spinosa* Thunb., the only original species.

DISTRIBUTION: Old World tropics from India to the Philippine Islands, Australia, and the New Hebrides. About 108 species, of which several are cultivated, one in Fiji.

USEFUL TREATMENT OF GENUS: Beccari in Ann. Bot. Gard. Calcutta 13: 109. 1933.

1. *Licuala grandis* H. Wendl. ex Linden in Ill. Hort. 28: 23. t. 412, nom. provis. 1881; H. Wendl. ex Hook. f. in Bot. Mag. 109: t. 6704. 1883; Becc. in Ann. Bot. Gard. Calcutta 13: 147. 1933; J. W. Parham, Pl. Fiji Isl. ed. 2. 371. 1972.

Trunk solitary, to 4 m. high; leaf blades undivided, nearly orbicular in outline, toothed along margin, to 0.9 m. across and 0.6 m. long; inflorescence elongate, with about 6 once-branched branches; flowers greenish brown, 5 mm. long, with bases of stamen filaments united in a 3-lobed ring and anthers on short free portions, 3 in a notch on each lobe and 3 in each sinus; fruit orange when mature, globose, 1-1.5 cm. in diameter.

TYPEIFICATION: The holotype (κ) consists of one large and two small sheets of material cultivated as "*Pritchardia grandis*" at Hort. Wills, Annerly, 1881, marked as type of Bot. Mag. *t.* 6704, with sketches of floral details. The last are not quite correct, as they show the stamens in a 6-lobed ring in an expanded androecium. The androecium sketched in an opened flower looks more like the characteristic 3-lobed structure known for the species.

DISTRIBUTION: New Hebrides on Malekula and Espiritu Santo; once thought to have been introduced from New Britain. The species is now widely cultivated.

USE: An ornamental, moderately commonly cultivated, according to Parham.

AVAILABLE COLLECTION: VITI LEVU: NAITASIRI: Nanduruloulou, cultivated at Experiment Station, Moore, Koroiveibau, & Parham 9365.

3. *PRITCHARDIA* Seem. & H. Wendl. in Bonplandia **9**: 260, nom. nud. 1861, in op. cit. **10**: 153, nom. nud. (June 1) 1862, in Bonplandia **10**: 197 (July 1), 309 (Oct. 15). 1862; Seem. Fl. Vit. 273. 1868; Becc. Malesia **3**: 281. 1890, in Webbia **4**: 202. 1913; Becc. & Rock in Mem. Bishop Mus. **8** (1): 1. 1921; Becc. in Ann. Bot. Gard. Calcutta **13**: 308. 1933. Nom. cons.

Eupritchardia Kuntze, Rev. Gen. Pl. **3** (2): 323. 1898.

Styloma O. F. Cook in J. Wash. Acad. Sci. **5**: 241. 1915.

Solitary, erect, pleoanthic, hermaphroditic palms; leaf blades costapalmate; segments 1-ribbed, acutely bifid, induplicate at insertion; petiole unarmed; inflorescence interfoliar, with a prophyll and 1-4 long-pedunculate panicles, each bearing several peduncular bracts; flowers bisexual, borne singly along the rachillae; sepals connate in a tubular, briefly 3-lobed calyx; petals 3, connate basally, valvate above and the lobes deciduous at anthesis; stamens 6, with filaments connate basally in a tube; carpels 3, connate by their styles only; fruit globose to ovoid, 1-seeded; seed with homogeneous endosperm and basal embryo.

TYPE SPECIES: *Pritchardia pacifica* Seem. & H. Wendl. Because of the existence of an earlier genus *Pritchardia* Unger ex Endl. (1842, a fossil genus), Kuntze renamed the palm genus *Eupritchardia*, with the same type species. O. F. Cook apparently was unaware of Kuntze's name and renamed *Pritchardia* Seem. & H. Wendl. as *Styloma*. As *Pritchardia* is now conserved for the palm genus, these substitute names are unnecessary.

DISTRIBUTION: Fiji Islands, Tonga, Dangerous Archipelago, and Hawaiian Islands. About 36 species or fewer, of which the two species treated here are widely cultivated and one or both are indigenous.

KEY TO SPECIES

- Panicles usually 2 or 3 in an axil, shorter than leaves; prophyll and more or less expanded peduncular bracts soon becoming softly and loosely fibrous. 1. *P. pacifica*
 Panicles always solitary in the axils, longer than leaves; prophyll and peduncular bracts tubular, closely sheathing the peduncle, becoming fibrous only at the tip or not at all. 2. *P. thurstonii*

1. *Pritchardia pacifica* Seem. & H. Wendl. in Bonplandia **9**: 260, nom. nud. 1861, in op. cit. **10**: 153, nom. nud., 197, 309. *t.* 15. 1862; Seem. Viti, 43, 86, 133, 367, 368, 444. 1862, Fl. Vit. 274. *t.* 79. 1868; Becc. Malesia **3**: 290. *t.* 37, fig. 13-15. 1890; Drake, Ill. Fl. Ins. Mar. Pac. 323. 1892; Hemsl. in J. Linn. Soc. Bot. **30**: 162. 195. 1894; Burkill in op. cit. **35**: 23, 57. 1901; Rechanger in Denkschr. Akad. Wiss. Wien **85**: 237. 1910; Becc. in Webbia **4**: 210. 1913; Becc. & Rock in Mem. Bishop Mus. **8** (1): 29. *t.* 24, fig. W. 1921; Becc. in Ann. Bot. Gard. Calcutta **13**: 308. 1933; Christophersen in Bishop Mus. Bull. **128**: 25. 1935; J. W. Parham in

Agr. J. Dept. Agr. Fiji **19**: 94. 1948, in op. cit. **29**: 33. 1959; Yuncker in Bishop Mus. Bull. **220**: 74. 1959; J. W. Parham, Pl. Fiji Isl. 278, fig. 98. 1964, ed. 2. 373. 1972; Sykes in New Zealand Dept. Sci. Indust. Res. Bull. **200**: 267. 1970.

Pritchardia pacifica var. *samoensis* Becc. in Webbia **4**: 206, 212. 1913; Becc. & Rock in Mem. Bishop Mus. **8** (1): 30. 1921.

? *Pritchardia pacifica* var. *marquisensis* F. Br. in Bishop Mus. Bull. **84**: 118. t. 25, fig. A. 1931.

Washingtonia pacifica Kuntze, Rev. Gen. Pl. **2**: 737. 1891.

Eupritchardia pacifica Kuntze, Rev. Gen. Pl. **3** (2): 323. 1898; Yuncker in Bishop Mus. Bull. **178**: 26. 1943, in op. cit. **184**: 27. 1945.

Styloma pacifica O. F. Cook in J. Wash. Acad. Sci. **5**: 241. 1915.

Trunk to 10 m. high or more, 30 cm. in diameter, brown-corky; leaf blades stiff, 1 m. long or more, divided about 1/3 to the base in the central portion with 73–90 segments; flowers yellow-green, 7–8 mm. long; fruit dark brown, globose, with pedicel-liform base, 11–12 (–16) mm. in diameter.

TIPIFICATION AND NOMENCLATURE: The holotype of the species is *Seemann 659* (κ, 2 sheets without locality data). This was the only collection cited by Seemann and Wendland in their first description (in *Bonplandia* **10**: 197). Later (in op. cit. **10**: 309) they cited collections from Tonga and Samoa. Although the precise locality of the Fijian collection was not noted by Seemann and Wendland, it is indicated in *Viti* (p. 86) that Seemann obtained specimens of *Pritchardia pacifica* in the town of Rewa (in the Rewa Delta, Rewa Province, Viti Levu), June 30 or July 1, 1860. Presumably these were from cultivated plants. The holotype of var. *samoensis* is *Powell s. n.* (κ) and that of var. *marquisensis* is *F. Brown 647A, B, C* (BISH).

DISTRIBUTION: Tonga, where apparently indigenous on 'Eua and Vava'u (Hemslay, 1894; Burkill, 1901; Yuncker, 1959). Although reported from Viti Levu and Vanua Levu by Seemann and others, it is not certain that the species is indigenous in Fiji, nor does it appear truly indigenous in Samoa (Rechinger, 1910; Christoffersen, 1935). It seems unlikely that the Marquesan representative, if it truly belongs to *Pritchardia pacifica*, is actually native. Brown (1931) notes that it is found only rarely in inhabited valleys.

LOCAL NAMES AND USES: The names *viu*, *masei*, *niu masei*, *sakiki*, *saii*, *niu saki-ki*, and *Fiji fan palm* have been applied to the species. The leaves were once used for fans, called *ira masei* or *ai viu*, which were reserved for chiefs only, and the trunks were sometimes used as ridge beams. Seemann's account (Fl. Vit. 274–275. 1868) of the uses and presumed distribution of *Pritchardia pacifica* is highly informative.

AVAILABLE COLLECTION: VANUA MBALAVU: Lomaloma (cultivated), *Bryan 587*.

2. *Pritchardia thurstonii* F. v. Muell. & Drude in Gartenflora **36**: 486. t. 123, t. 124, fig. 1–8, as *P. thurstoni*. 1887, in Gard. Chron. III. **2**: 341, as *P. thurstoni*. 1887; Becc. Malesia **3**: 290. t. 37, fig. 1–12. 1890, in Webbia **4**: 212. 1913; Becc. & Rock in Mem. Bishop Mus. **8** (1): 31. 1921; Becc. in Ann. Bot. Gard. Calcutta **13**: 309. 1933; Burret in Occas. Pap. Bishop Mus. **11** (4): 3, as *P. thurstoni*. 1935; J. W. Parham, Pl. Fiji Isl. 278. 1964, ed. 2. 373. 1972.

FIGURE 13 (lower).

Washingtonia thurstonii Kuntze, Rev. Gen. Pl. **2**: 737. 1891.

Eupritchardia thurstonii Kuntze, Rev. Gen. Pl. **3** (2): 323. 1898.

Styloma thurstonii O. F. Cook in J. Wash. Acad. Sci. **5**: 241. 1915.

Trunk to about 8 m. high and 20 cm. in diameter; leaves divided nearly to middle in the central portion with 50–70 segments; flowers 5–7 mm. long; perianth pale yellow, strongly nerved when dry, the sepals 3 mm. long, the petals about 5 mm. long; fruit deep red, globose, 6–7 mm. in diameter, often crowned with persistent remains of abortive carpels and the style.

TYPEIFICATION: The type collection was made by J. B. Thurston on one of the eastern islands (Lau Group) in 1886, but no holotype specimen was designated. It seems wise, therefore, to designate as lectotype *Thurston s. n.* at MEL from which flowers and fruits were presumably sent to Drude at Dresden. There is an isoelectotype at K, consisting of a photo, a drawing made from it, and packets of flowers and fruits.

DISTRIBUTION: Apparently endemic to the eastern islands of Fiji, occurring on limestone. It is more abundant locally than the few available collections suggest.

LOCAL NAMES: *Viu, masai, niu sawa.*

AVAILABLE COLLECTIONS: FULANGA: On limestone formation, *Smith 1230*. ONGEA NDRIKI: *Bryan 389*.

4. *CORYPHA* L. Sp. Pl. 1187. 1753.

Solitary, erect, very large, hermaphroditic, hapaxanthic palms; leaf blades costapalmate; segments 1-ribbed, acutely bifid, induplicate at insertion; petiole spinose-toothed along margins; inflorescence suprafoliar, massive, compound, of many primary units from axils of reduced leaves or bracts, most units with several branches along axis and these subtended by a tubular bract and again branched one or more times; flowers bisexual, borne in adnate cincinni along rachillae; sepals connate in a 3-lobed calyx; petals 3, distinct, slightly imbricate; stamens 6; ovary 3-locular, 3-ovulate; style slender; stigmas 3, punctiform; fruit globose, 1-3-seeded; seed with homogeneous endosperm and nearly apical embryo.

TYPE SPECIES: *Corypha umbraculifera* L., the only species of Linnaeus in 1753.

DISTRIBUTION: Old World tropics from India and Ceylon to Philippine Islands and northeastern Australia. About eight species, of which two are widely cultivated, one of them recorded from Fiji.

USEFUL TREATMENTS OF GENUS: Blatter, *Palms Brit. India & Ceylon*, 69. 1926; Beccari in *Ann. Bot. Gard. Calcutta* 13: 10. 1933.

1. *Corypha elata* Roxb. Hort. Beng. 25, nom. nud. 1814, Fl. Ind. ed. 2. 2: 176. 1832; B. E. V. Parham in *Agr. J. Dept. Agr. Fiji* 10: 114. 1939.

Trunk to 20 m. high or more, nearly 1 m. in diameter; leaf blades very large and heavy, to 3 m. across or more; petioles to nearly 4 m. long; inflorescence to 4.5 m. high, with more than 45 primary axillary branches; flowers small, pale yellow; fruit olive-green, globose, about 2.5 cm. in diameter.

TYPEIFICATION: Described from a plant that flowered in the Botanical Garden at Calcutta (Beccari, 1933, cited above); no type specimen has been located.

DISTRIBUTION: Reported by Roxburgh to have come from Bengal, but more likely introduced into Calcutta from elsewhere; Beccari indicates its range as Indonesia to the Philippine Islands. It is likely that material from New Guinea and northeastern Australia may also prove to represent this species. No herbarium voucher supports the record, but B. E. V. Parham (1939, cited above) reported that the species was introduced into Fiji in 1924 and was growing well in 1939 on the property of W. L. Wallace, Tovu Island, Ra Province, Viti Levu.

USE: An important economic palm throughout its natural range; Parham mentions that sugar is produced from the terminal bud.

5. *PHOENIX* L. Sp. Pl. 1188. 1753.

Solitary or caespitose, erect or "acaulescent," pleonanthic, dioecious palms; leaf blades imparipinnate; pinnae 1-ribbed, acute, induplicate at insertion, the lower ones modified into stout spines; inflorescence interfoliar; peduncle flattened, bearing a caducous, often bivalved prophyll but no peduncular bracts; rachillae simple,

often fasciculately arranged; flowers unisexual, borne singly along rachillae; staminate flowers with 3 sepals connate in a low cupule; petals 3, valvate; stamens usually 6; pistillode lacking or of 3 abortive carpels or a trifid rudiment; pistillate flowers with sepals connate in a 3-lobed cupule; petals imbricate; staminodes usually 6, scalelike or connate; carpels 3, distinct; fruit ovoid to oblong, smooth, fleshy; seed elongate, cylindrical or plano-convex and deeply grooved below raphe; endosperm homogeneous; embryo lateral or subbasal.

TYPE SPECIES: *Phoenix dactylifera* L., the only species originally included by Linnaeus.

DISTRIBUTION: Old World tropics and subtropics from Africa and Crete to Malaya and Sumatra. About 17 or 18 species, of which one is widely cultivated for its edible fruit and several are grown as ornamentals. Four have been introduced into Fiji.

USEFUL TREATMENTS OF GENUS: Beccari, *Malesia* 3: 345. 1890; Mahabale & Parthasarathy in *J. Bombay Nat. Hist. Soc.* 60: 371-387. 1963.

KEY TO SPECIES

Stout palms with leaves 3 m. long or more; pinnae stiff, more than 15 mm. wide.

Corolla of pistillate flowers twice as long as calyx; foliage mostly glaucous or glaucescent; leaf scars as high as or higher than broad.

Fruit cylindrical; seeds often acutely compressed; pinnae mostly in 1 or 2 planes; stems caespitose when not pruned. 1. *P. dactylifera*

Fruit oliviform or oblong-elliptic; seed rounded; pinnae mostly in 2-4 planes; stems solitary.

2. *P. sylvestris*

Corolla of pistillate flowers scarcely exceeding calyx; pinnae deep green; leaf scars broader than high.

3. *P. canariensis*

Dwarf palms with leaves 1-1.5 m. long; pinnae soft, 7-12 mm. wide. 4. *P. roebelenii*

1. *Phoenix dactylifera* L. Sp. Pl. 1188. 1753; Becc. *Malesia* 3: 355. *t.* 43, *fig.* 1-14. 1890; J. W. Parham in *Agr. J. Dept. Agr. Fiji* 19: 94. 1948, in *op. cit.* 29: 33. 1959, *Pl. Fiji Isl.* 277. 1964, ed. 2. 371. 1972; Sykes in *New Zealand Dept. Sci. Indust. Res. Bull.* 200: 267. 1970.

Stems several, or offshoots often removed in cultivation, to more than 30 m. high, with leaf scars higher than broad; leaves gray-green, rather stiff, to 3 m. long or more; pinnae numerous on each side, often borne in pairs and in 1 or 2 planes; staminate inflorescence short-pedunculate, with whitish, fragrant flowers 7-8 mm. long, the petals somewhat rounded; pistillate inflorescence long-pedunculate, with whitish, globose flowers 4-4.5 mm. long, the petals about twice as long as calyx; fruit oblong-ellipsoid, yellowish brown or reddish at maturity, 4-7 cm. long, 2-3 cm. in diameter, with sweet flesh.

LECTOTYPIFICATION: Linnaeus gives many prior references, and an appropriate lectotypification still remains to be indicated.

DISTRIBUTION: Warm, dry regions of North Africa and the Middle East to the Indus Basin. Cultivated from prehistoric times and introduced widely for its edible fruit. No herbarium vouchers of the species are available from Fiji, but Parham indicates that it is cultivated in the Suva Botanical Gardens and is also naturalized near Nandi, Viti Levu.

LOCAL NAMES AND USES: *Date palm*, *kajoor*. It was introduced into Fiji in the 1880's as an ornamental. Although *Phoenix dactylifera* is a very important economic plant in other parts of the world, especially for its edible fruits, no such uses are recorded from Fiji.

2. *Phoenix sylvestris* (L.) Roxb. Hort. Beng. 73. 1814, Fl. Ind. ed. 2. 3: 787. 1832; Becc. Malesia 3: 364. t. 43, III, fig. 26-37. 1890; J. W. Parham in Agr. J. Dept. Agr. Fiji 19: 94. 1948, in op. cit. 29: 33. 1959; Blatter, Palms Brit. India & Ceylon, 3. 1926; Mahabálé & Parthasarathy in J. Bombay Nat. Hist. Soc. 60: 374. t. 1, fig. 1; t. 4, fig. 13-15; t. 5, fig. 17; t. 6, fig. 23, 24. 1963.

Elate sylvestris L. Sp. Pl. 1189. 1753.

Much like *Phoenix dactylifera*, but the stems solitary and shorter, to 16 m. high, the leaves less rigid, with pinnae in 2-4 ranks, and fruits orange-yellow, 2-3 cm. long, 1.2-1.4 cm. in diameter, with astringent flesh.

LECTOTYPIFICATION: Although Linnaeus cites several prior references, an adequate lectotypification is not known to me.

DISTRIBUTION: India, where it is common as a wild or cultivated tree nearly throughout, and up to altitudes of 1,600 m.

LOCAL NAMES AND USES: *Indian date palm* and *wild date palm* are listed by Parham (1948, cited above) in reference to an ornamental growing in the Suva Botanical Gardens; however, it may not have survived there, as the record is dropped from his *Plants of the Fiji Islands*.

AVAILABLE COLLECTION: VITI LEVU: MBA: Nandi, DA L.17089.

3. *Phoenix canariensis* Hort. ex Chabaud in La Provence Agricole 19: 293. fig. 66-68. 1882; Becc. Malesia 3: 369. t. 43, fig. 15-25. 1890; J. W. Parham in Agr. J. Dept. Agr. Fiji 19: 93. fig. 6. 1948; Sykes in New Zealand Dept. Sci. Indust. Res. Bull. 200: 267. 1970.

Stem solitary, massive, to 14 m. high and nearly 1 m. in diameter, with leaf scars broader than high; leaves dark green, very numerous, to 6 m. long, with 150-200 pinnae on each side, the lower ones clustered, those of the upper half regularly arranged; staminate inflorescence like that of *Phoenix dactylifera*, with obtuse flowers 9-10 mm. long; pistillate flowers depressed-globose, 4-4.5 mm. in diameter, the petals scarcely longer than calyx; fruit elliptic-ovoid, yellow, 2 cm. long, 1.5 cm. in diameter, with dry flesh.

TYPIFICATION: Described from cultivated plants without designation of type.

DISTRIBUTION: Canary Islands; now widely cultivated as an ornamental.

LOCAL NAME AND USE: *Canary date palm* is indicated by Parham (1948, cited above) for this striking ornamental that he recorded from the Suva Botanical Gardens. It is not listed in his later compilations, but it is still sparingly cultivated on Niue (Sykes, 1970, cited above).

4. *Phoenix roebelenii* O'Brien in Gard. Chron. III. 6: 475, 758, nom. provis. 1889; O'Brien ex Becc. in Bull. Mus. Hist. Nat. (Paris) 17: 156, as *P. roebelinii*. 1911; Sykes in New Zealand Dept. Sci. Indust. Res. Bull. 200: 267. 1970.

Stems solitary or sometimes cespitose, to about 6 m. high, 7.5-10 cm. in diameter; leaves 1-1.5 (-2) m. long; pinnae about 50 on each side, mostly in pairs, dark green, soft, 20-40 cm. long, 7-12 mm. wide; staminate flowers acute, with petals 7-8 mm. long; pistillate corolla about 4 mm. long in fruit, about twice as long as the acutely lobed calyx; fruit 15-18 mm. long, 6-7 mm. in diameter, apiculate.

TYPIFICATION: Type not indicated.

DISTRIBUTION: Laos, on banks of Mekong River; cultivated elsewhere.

AVAILABLE COLLECTION: VITI LEVU: NAITASIRI: Near Sawani, Waimanu River, cultivated, DA L.18580 (coll. S. Vodonaivalu).

Until the very recent collection cited above, this species had not been noted in cultivation in Fiji. It is also very sparingly grown on Niue (Sykes, 1970, cited above).

6. *LATANIA* Commerson ex Juss. Gen. Pl. 39. 1789.

Cleophora Gaertn. Fruct. Sem. Pl. 2: 185. 1791.

Solitary, stout, erect, pleonanthic, dioecious palms; leaf blades costapalmate; segments 1-ribbed, acutely bifid, induplicate at insertion; petiole often toothed along margins basally; inflorescences dimorphic, the staminate axis elongate, with a prophyll and several tubular peduncular bracts below several to many primary branches, each branch subtended by a tubular bract and with several catkinlike rachillae more or less digitately arranged; staminate flowers solitary in pits formed by connation of bracts; calyx 3-lobed; petals 3, connate basally and adnate to the elongate receptacle, imbricate distally; stamens 15-30 or more; pistillode prominent; pistillate inflorescence with fewer, spicate branches bearing sessile flowers surrounded by 2 bracteoles; pistillate flowers larger than staminate; 3 sepals and 3 petals imbricate; staminodes connate basally at base of trilocular, triovulate ovary; fruit large, oblong or obovoid, 1-3-seeded; endocarps enclosing seeds obovoid, variously ridged and sculptured; endosperm homogeneous.

TYPE SPECIES: *Latania borbonica* Lam. (vide Lam. Encycl. Méth. Bot. 3: 427. 1792) = *L. lontaroides* (Gaertn.) H. E. Moore.

DISTRIBUTION: Mascarene Islands. Three species, of which one is recorded as cultivated in Fiji.

USEFUL TREATMENTS OF GENUS: Balfour f. in J. G. Baker, Fl. Mauritius and Seychelles, 380. 1877; Beccari, Palme della tribù Borasseae, 14. 1924; L. H. Bailey in Gentes Herb. 6: 58. 1942.

1. *Latania lontaroides* (Gaertn.) H. E. Moore in Principes 7: 85. 1963.

Cleophora lontaroides Gaertn. Fruct. Sem. Pl. 2: 185. t. 120, fig. 1. Apr.-Mai, 1791.

Latania borbonica Lam. Encycl. Méth. Bot. 3: 427. 13 Feb. 1792; L. H. Bailey in Gentes Herb. 6: 62. t. 32-34, 37, 39-41. 1942; J. W. Parham in Agr. J. Dept. Agr. Fiji 19: 93. 1948.

Latania commersonii J. F. Gmelin, Syst. Nat. 2: 1035. Apr.-Oct. 1792.

Latania rubra Jacq. Fragm. Bot. 13. t. 8. 1801.

Trunks to 16 m. high; leaves long-petiolate, the blades to 1.8 m. long, gray-green to slightly glaucous but with red-tinged petiole and palman; inflorescences 1-2 m. long, the staminate with 9-16 branches, each with 3-5 rachillae and flowers 8 mm. long, the pistillate with rachillae 45 cm. long and flowers 12 mm. in diameter; endocarps 3-4.5 cm. long, 2.5 cm. wide, with curved low ridges abaxially and over the rounded apex.

TYPE SPECIES: The type of *Cleophora lontaroides* is the fruit in the Gaertner herbarium (TUB), if extant, or Fruct. Sem. Pl. t. 120, fig. 1. The type of *Latania borbonica* and *L. commersonii* is *Commerson s. n.* (P-LAM); that of *L. rubra* is the Jacquuin description and t. 8 in Fragm. Bot.

DISTRIBUTION: Réunion. The only record of the cultivation of this species in Fiji is that of Parham in 1948; since it is not mentioned in his later compilations the plant may not have survived in Fiji. Parham's description of leaves with a heavy bloom, together with a putative origin in Mauritius, suggests that his material may actually have represented *Latania loddigesii* Mart., a native of Mauritius, which has glaucous leaves, tomentose staminate axes, and narrowly obovoid endocarps with markedly anastomosing abaxial ridges above the middle and over the apex.

USE: Ornamental.

7. *METROXYLON* Rottb. in Nye Saml. Kongel. Danske Vidensk. Selsk. Skr. 2: 527. 1783. Nom. cons.

Sagus Steck, De Sagu, 21. 1757; sensu Seem. Fl. Vit. 279. 1868. Nom. rejic.

Coelococcus H. Wendl. (in Bonplandia 9: 260, nom. nud. 1861) in Bonplandia 10: 199. 1862.

Solitary or cespitose, erect, hapaxanthic or rarely pleonanthic, polygamomonoecious or monoecious palms; leaf blades paripinnate; pinnae acute, 1-ribbed, reduplicate at insertion; inflorescence rarely interfoliar, mostly suprafoliar, then compound, of many primary units from axils of reduced leaves or bracts, each unit of interfoliar or suprafoliar inflorescences with a prophyll and several tubular peduncular bracts; flowers bracteolate, paired in axils of marginally connate bracts, one staminate, the other pistillate or more likely bisexual; calyx 3-lobed; petals 3, valvate; stamens 6; ovary trilobular, triovulate, and covered with imbricate scales, or, in staminate flowers, reduced; fruit globose to pyriform, 1-seeded, covered with imbricate scales; seed often hollow; endosperm homogeneous.

TYPE SPECIES: *Metroxylon sagu* Rottb. The type species of *Coelococcus* is *C. vitiensis*; that of *Sagus* is *S. genuina* Giseke (vide H. E. Moore in *Taxon* **11**: 165, 1962).

DISTRIBUTION: Indonesia (where perhaps only cultivated) to Caroline Islands, New Guinea, Solomons, New Hebrides, Fiji, and Samoa. About six species, of which one is endemic to Fiji.

USEFUL TREATMENTS OF GENUS: Beccari in *Ann. Bot. Gard. Calcutta* **12**: 156, 1918; Barrau in *Econ. Bot.* **13**: 150, 1959.

1. *Metroxylon vitiense* (H. Wendl.) H. Wendl. ex Hook. f. in *Rep. Kew Gard.* **1882**: 68, 1884; Benth. & Hook. f. ex Drake, Ill. *Fl. Ins. Mar. Pac.* 323, 1892; Becc. in *Ann. Bot. Gard. Calcutta* **12**: 185, *t.* 110, 1918; B. E. V. Parham in *Agr. J. Dept. Agr. Fiji* **10**: 21, 1939; A. C. Sm. in *Smithsonian Rep.* **1954**: opp. 310, *pl.* 6, 1955; J. W. Parham in *Agr. J. Dept. Agr. Fiji* **29**: 33, as *M. vitiensis*, 1959, *Pl. Fiji Isl.* 275, *fig.* 96, 1964, ed. 2, 371, *fig.* 102, 1972; Tomlinson in *Principes* **15**: 49, *fig.* 1-4, 10, 13, 17-28, 1971. FIGURES 28, 81.

Coelococcus vitiensis H. Wendl. ex Seem. in *Bonplandia* **9**: 260, nom. nud. 1861; H. Wendl. in *Bonplandia* **10**: 199, 1862; Warb. in *Ber. Deutsch. Bot. Ges.* **14**: 141, *t.* 10, *fig.* 12, 1896.

Sagus vitiensis H. Wendl. ex Seem. *Viti*, 96, 288, 291, 367, 444, 1862; Seem. *Fl. Vit.* 279, *t.* 80, 1868.

Trunk to 15 m. high and 1 m. in diameter, covered with root-spines 1-3 cm. long; leaves numerous, upright, the blades to 5 m. long, the petiole and rachis spiny; inflorescence 2-4 m. high; primary units 15-20 or more, to 3 m. long, each with 20 or more distichously arranged, pendulous branches bearing a few rachillae to 10 cm. long; fruit globose or globose-ovoid, to 6.5 cm. long and 6 cm. in diameter; seed invaginated.

TYPIFICATION: The type is *Seemann 658*; although the place of deposit was not mentioned by Wendland, it seems certain that the Kew sheets were the ones studied by him. There are two sheets of *Seemann 658* at Kew, neither bearing a locality; in his 1862 publication Wendland mentioned "Viti Levu, Vanua Levu, Ovalau." In *Flora Vitiensis* (p. 279) Seemann indicates that he observed *Sagus vitiensis* when he and Pritchard visited Chief Kuruduadua at Navua. It was first seen on July 4, 1860, from the Tonguru River (the present coastal dividing line between Namosi and Serua Provinces) westward, and fine groves were seen on the various branches and deltas of the Navua River (cf. also *Viti*, 95-96, 1862). The species was afterward ascertained to grow on Ovalau, where Seemann and Pritchard cut six trees of it, in order to make sago from the starch of the trunks. It was also observed in northeastern Vanua Levu by the missionary Mr. Waterhouse and Col. Smythe. Although *Seemann 658* could indeed have been collected along the lower Navua River, Serua Province, Viti Levu, between July 4 and 9, 1860, it would seem just as likely that the herbarium material was obtained from the Ovalau plants. No date (other than after



FIGURE 81. *Metroxylon vitiense*, from Smith 9339. (Upper) Distal portion of inflorescence. (Lower) Petioles and lower portions of leaf blades.

July in 1860) is assignable to the Ovalau collection, as Seemann spent many periods there as Pritchard's guest.

DISTRIBUTION: Endemic to Fiji, and thus far observed only on Viti Levu, Ovalau, and Vanua Levu. Evidently collectors do not like to prepare specimens of this unwieldy and very spiny plant.

LOCAL NAMES AND USES: *Songo; songa; niu soria; sago*; the last is evidently an English name. It is possible that the palm called *ota* or *oat* on Rotuma (*St. John 19094*) is the same species. Although the pith of the trunk is edible, it apparently is not used in Fiji (although *St. John* indicates that it is so used on Rotuma). The leaves are considered to provide the best thatching material in Fiji, and, perhaps because of the abundance of the species there, the men of Serua Province are known as superior house-builders.

AVAILABLE COLLECTIONS: VITI LEVU: SERUA: Flat coastal strip in vicinity of Ngaloa, *Smith 9339*. NAITASIRI: Nanduruloulou, *DA 16551* (coll. *P. B. Tomlinson*).

Seemann (*Fl. Vit.* 279–280, 1868) gives an excellent account of this seldom collected species. A. C. Smith (in litt.) is of the opinion that the Rotuma plant (cultivated?) represents *Metroxylon vitiense*; although it is administratively a part of Fiji, Rotuma is not covered by the present *Flora*.

8. *RAPHIA* Beauv. *Fl. Oware* 1: 75. t. 44–46. 1806.

Solitary or caespitose, erect or “acaulescent,” hapaxanthic, monoecious palms; leaf blades paripinnate; pinnae 1-ribbed, acute, reduplicate at insertion; inflorescence terminating stem, compound, of many erect or several pendulous primary units from axils of reduced leaves or bracts, each unit with a prophyll, several peduncular bracts, and many branches bearing short rachillae with pistillate flowers in lower portion and staminate flowers distally; calyx cup-shaped or 3-lobed in both sexes; staminate flowers with 3 valvate petals and 6–20 or more stamens; pistillate flowers with 3 valvate petals connate basally, a staminodial ring, and trilobular, triovulate ovary covered with imbricate scales; fruit 1-seeded, covered with imbricate scales; seed with ruminate endosperm.

LECTOTYPE SPECIES: *Raphia vinifera* Beauv. (vide Jumelle & Perrier de la Bathie in Humbert, *Fl. Madagascar et Comores*, *Fam.* 30: 14, 1945).

DISTRIBUTION: About 30 species in Africa south of the Sahara and in Madagascar; one species in the New World from Nicaragua to Brazil. One species is recorded as cultivated in Fiji.

USEFUL TREATMENTS OF GENUS: Beccari in *Webbia* 3: 37, 1910; Russell in *Kew Bull.* 19: 173, 1965.

1. *Raphia farinifera* (Gaertn.) Hylander in *Lustgård* 31–32: 88. 1952.

Sagus farinifera Gaertn. *Fruct. Sem. Pl.* 2: 186. t. 120, fig. 3. 1791.

Sagus ruffia Jacq. *Fragm. Bot.* 7. t. 4, fig. 2. 1801.

Raphia pedunculata Beauv. *Fl. Oware* 1: 78. t. 44, fig. 2; t. 46, fig. 2. 1806; B. E. V. Parham in *Agr. J. Dept. Agr. Fiji* 10: 116. 1939.

Sagus pedunculata Poir. in *Lam. Encycl. Méth. Bot. Suppl.* 5: 13. 1817, *Tabl. Encycl. Méth. Bot.* 3: 357. t. 771, fig. 2a–g. 1823.

Metroxylon ruffia Spreng. *Syst. Veg.* 2: 139. 1825.

Raphia ruffia Mart. *Hist. Nat. Palm.* 3: 217. 1838.

Raphia tamatavensis Sadebeck in *Bot. Jahrb.* 36: 354. 1905.

Trunk solitary, to 8 m. high; leaves to 15 m. long or more; pinnae biseriate, more or less paired; inflorescence of several large, pendulous or recurved primary units to more than 3 m. long, each with many branches bearing compressed rachillae to 15 cm. long; staminate flowers with 6–9 stamens; pistillate flowers with corolla in-

cluded in calyx; fruit shining dark brown, more or less turbinate, to 6.5 cm. long, with scales in 12 or 13 vertical rows.

TYPEIFICATION: The type of *Sagus farinifera* is a specimen in the Gaertner herbarium (TUB), if extant, or Fruct. Sem. Pl. t. 120, fig. 3. The type of *S. ruffia* is Fragm. Bot. t. 4, fig. 2; that of *Raphia pedunculata* is Beauvois s. n. (G). No type was designated for *R. tamatavensis*.

DISTRIBUTION: Madagascar, eastern to central Africa, and perhaps west to Cameroon. Parham (1939, cited above) indicates that the species was introduced into Fiji in 1918 and that in 1939 it was growing slowly on the property of W. L. Wallace, Tovu Island, Ra Province, Viti Levu. Perhaps it has not persisted in cultivation in Fiji, as it is not included in later compilations.

LOCAL NAMES AND USE: *Raffia*; *raphia*. The species was probably introduced into Fiji as a potential source of fiber from the leaves.

9. *CALAMUS* L. Sp. Pl. 325. 1753; A. C. Sm. in J. Arnold Arb. 36: 274. 1955.

Solitary or mostly cespitose, erect, "acaulescent," or mostly scandent, pleonanthic, dioecious palms, usually armed with spines on some or all parts; leaf sheaths tubular, often with an ocrea at mouth, sometimes bearing a clawed, lateral flagellum; leaf blades usually paripinnate or produced in a clawed cirrus; prophyll, peduncular bracts, and bracts subtending branches usually tubular and persistent or marcescent; flowers with a 3-lobed calyx and 3 petals, the staminate flowers usually solitary, with 6 stamens and small pistillode; pistillate inflorescence with flowers usually paired, one pistillate, the other sterile; staminodes connate in a cupule; ovary trilocular, triovulate, covered with imbricate scales; fruit usually 1-seeded, covered with imbricate scales; seed with homogeneous or ruminate endosperm.

TYPE SPECIES: *Calamus rotang* L., the only original species.

DISTRIBUTION: Probably 300–400 species from tropical Africa, India, and Ceylon to the Philippine Islands, Indonesia, New Guinea, northeastern Australia, Solomon Islands, New Hebrides, and Fiji, where one species is indigenous.

USEFUL TREATMENT OF GENUS: Beccari in Ann. Bot. Gard. Calcutta 11 (1): 1. 1908.

1. *Calamus vitiensis* Warb. ex Becc. in Ann. Bot. Gard. Calcutta 11 (1): 350. t. 143. 1908; A. C. Sm. in J. Arnold Arb. 31: 144. 1950, in op. cit. 36: 274. 1955; J. W. Parham, Pl. Fiji Isl. 272. 1964, ed. 2. 368. 1972.

Solitary, high-climbing liana to 15 m. or more; leaves about 2 m. long, terminating in a clawed cirrus; sheaths dark green with chocolate-brown indument and straight spines, ocrea not developed; petiole essentially lacking; rachis with spines on upper surface; pinnae 15–19 on each side, soft, green, acute, with 2 prominent veins on each side of midrib, to 33 cm. long and 6 cm. wide; inflorescence not flagelliferous, with about 4 branches; fruits whitish at maturity, about 9–10 mm. in diameter.

TYPEIFICATION: The holotype was *Weber 111* (B), collected on Taveuni in 1881 and probably now destroyed; it is represented by the photographic plate in Ann. Bot. Gard. Calcutta 11 (1): t. 143. 1908.

DISTRIBUTION: Endemic to Fiji and known only from Viti Levu and Taveuni, occurring from near sea level to about 600 m., or possibly higher on Taveuni, where it is sometimes locally frequent.

LOCAL NAMES AND USES: The names *ngganuya*, *ngganua*, and *watemburetathi* have been recorded by collectors; the stems are used for baskets, walking sticks, etc.

AVAILABLE COLLECTIONS: VITI LEVU: NAITASIRI: Navuakethe or Namaka, above Nanduna, *DA 5642*. TAVEUNI: Slopes of Mt. Manuka, east of Wairiki, *Smith 8132*; Likuvasomo, Ura Estate on road to Vuna, southern end of island, *Moore, Koroiveihau, & Waibuta 9357*; track to Mt. Uluungalau, *DA 14078*.

10. *ARENGA* Labill. in DC. in Bull. Sci. Soc. Philom. Paris 2: 162. 1800; Labill. in Mém. Cl. Sci. Math. Inst. Nat. France 4: 209, as *Areng*. 1803. Nom. cons.

Saguerus Steck, De Sagu, 15. 1757. Nom. rejic.

Gomutus Correa in Ann. Mus. Hist. Nat. (Paris) 9: 288. 1807.

Blancoa Bl. Rumphia 2: 128. 1843.

Didymosperma H. Wendl. & Drude ex Hook. f. in Benth. & Hook. f. Gen. Pl. 3: 917. 1883.

Solitary or cespitose, erect, hapaxanthic or pleoanthic, monoecious or dioecious palms; leaf blades imparipinnate or rarely undivided; pinnae 1-ribbed, nearly linear to cuneate or undulate-lobed, praemorse at apex, toothed above middle, often auriculate basally where induplicate at insertion; inflorescences solitary or several at a node, usually maturing basipetally on the tree, rarely acropetally, branched or spicate; prophyll and several peduncular bracts tubular; flowers usually in triads of 2 staminate and a pistillate, or one or the other sex aborted and the inflorescence unisexual; staminate flowers with 3 imbricate sepals, 3 valvate petals, and 6-many stamens; pistillate flowers with 3 imbricate sepals, 3 petals connate to middle and valvate above, minute (or absent) staminodes, and trilocular or bilocular, triovulate or biovulate ovary; fruit 1-3-seeded, with irritant flesh; seeds with homogeneous endosperm.

TYPE SPECIES: *Arenga saccharifera* Labill. The type species of *Saguerus* is *S. pinnatus* Wurm; that of *Gomutus* is *G. rumphii* Correa; and that of *Blancoa* is *Caryota tremula* Blanco. The lectotype of *Didymosperma* is *Wallichia porphyrocarpa* Bl. ex Mart. (vide Pichi-Serm. in Webbia 11: 170. 1955).

DISTRIBUTION: Himalayas to Taiwan, Ryukyu Islands, Philippine Islands, Indonesia, New Guinea, and northeastern Australia. About 17 species, of which one has been cultivated in the Suva Botanical Gardens.

USEFUL TREATMENT OF GENUS: H. E. Moore in Principles 4: 112. 1960.

1. *Arenga pinnata* (Wurm) Merr. Interpret. Rumph. Herb. Amb. 119. 1917.

Saguerus pinnatus Wurm in Verh. Batav. Genootsch. Kunsten 1: 351. 1781.

Arenga saccharifera Labill. ex DC. in Bull. Sci. Soc. Philom. Paris 2: 162. 1800; Labill. in Mém. Cl. Sci. Math. Inst. Nat. France 4: 215. t. 6, 7, as *Areng* s. 1803; J. W. Parham in Agr. J. Dept. Agr. Fiji 29: 31. 1959.

Trunk to more than 10 m. high; leaves numerous, large, to nearly 10 m. long; pinnae to 115 on each side, linear, clustered, borne in several planes, dark green above, whitish beneath, auricled at base; sheaths coarsely fibrous with very stout, black spines like knitting needles; inflorescences solitary, usually unisexual; staminate flowers deep red to purple-black, with numerous bright stamens; pistillate flowers green; fruit to 6 cm. long; seeds black.

TYPEIFICATION: The holotype of *Saguerus pinnatus* is *Palma indica vinaria secunda* Rumph. Herb. Amb. 1: 57. t. 13. 1741. Although Wurm also cited Houtt. Nat. Hist. 2: 410, it is clear that Houttuyn's information and his t. 4, fig. 2 are taken from Rumphius. The holotype of *Arenga saccharifera* is *Labillardière s. n.* (FI-WEBB).

DISTRIBUTION: Indonesia, where presumably both indigenous and cultivated; cultivated elsewhere as an economic and ornamental palm, especially in the Asiatic tropics. Parham (1959, cited above) indicates that it was cultivated in the Suva Botanical Gardens, but he did not list it in later compilations.

LOCAL NAME AND USES: *Sugar palm*; a detailed account of the species is given by Burkill, Dict. Econ. Prod. Malay Penins. ed. 2. 232-238. 1966.

11. *CARYOTA* L. Sp. Pl. 1189. 1753.

Solitary or cespitose, dwarf to large, hapaxanthic, monoecious palms; leaf blades bipinnate, the pinnules cuneate, toothed on the truncate apex; inflorescences solitary at nodes, with prophyll and several tubular peduncular bracts; flowers in triads of 2 staminate and a pistillate, at least basally on rachillae; staminate flowers with 3 imbricate sepals, 3 valvate petals, and (6-) 9-100 or more stamens; pistillate flowers with 3 imbricate sepals, 3 petals connate in basal third and valvate above, minute (or absent) staminodes, and trilocular ovary with 1 or 2 locules fertile; fruit red to blackish, 1- or 2-seeded; seeds with ruminate endosperm.

TYPE SPECIES: *Caryota urens* L., the only original species.

DISTRIBUTION: India and Ceylon to the Philippine Islands, New Guinea, the Solomon Islands, and the New Hebrides. About twelve or more species, of which two are cultivated in Fiji.

USEFUL TREATMENTS OF GENUS: Beccari & Pichi-Sermolli in *Webbia* 11: 168. 1955; H. E. Moore in *Principes* 4: 116. 1960.

KEY TO SPECIES

- Stems cespitose; leaves to about 3 m. long; rachillae about 30 cm. long; staminate flowers with about 17 stamens. 1. *C. mitis*
 Stems solitary; leaves to about 6 m. long; inflorescence to more than 3 m. long with very long rachillae; staminate flowers with about 40 stamens. 2. *C. urens*

1. *Caryota mitis* Lour. Fl. Cochinch. 569. 1790; J. W. Parham in Agr. J. Dept. Agr. Fiji 19: 92. 1948, in op. cit. 29: 32. 1959, Pl. Fiji Isl. 272. 1964, ed. 2. 368. 1972.

Stems cespitose, to 13 m. high and 12.5 cm. in diameter; leaves to about 3 m. long; inflorescence short, with rachillae about 30 cm. long; staminate flowers with about 17 stamens; fruit blackish, about 12 mm. in diameter.

TIPIFICATION: Merrill (in Trans. Amer. Philos. Soc. 24 (2): 94. 1935) reports that a Loureiro specimen named by Dryander is preserved at BM; possibly this may be considered the holotype.

DISTRIBUTION: Burma to southeastern Asia and Indonesia; cultivated elsewhere. No vouchers are available for the Fijian record, although Parham indicates that it is moderately common in Fiji, occurring in the Suva Botanical Gardens and elsewhere.

LOCAL NAMES AND USES: *Fish tail palm*; *lesser fish tail palm*. It is grown as an ornamental, but has many other uses in Malesia (Burkill, Dict. Econ. Prod. Malay Penins. ed. 2. 476-477. 1966).

2. *Caryota urens* L. Sp. Pl. 1189. 1753; J. W. Parham, Pl. Fiji Isl. 272. 1964, ed. 2. 368. 1972.

Stems usually solitary, to about 20 m. high; leaves to about 6 m. long or more; inflorescence to more than 3 m. long, with very long rachillae; staminate flowers with about 40 stamens; fruit red, about 18 mm. in diameter.

TIPIFICATION: Linnaeus gives several prior references and a description, but I have not noted an adequate lectotypification.

DISTRIBUTION: India and Ceylon; cultivated elsewhere. Parham mentions it as an early introduction into Fiji, less common than *Caryota mitis*, but no vouchers are available.

LOCAL NAME AND USES: *Toddy palm*; although cultivated as an ornamental, this species in India and Ceylon is an important source of sugar, toddy, fiber, and construction materials.

12. *Roystonea* O.F. Cook in Science II. 12: 479. 1900.

Oreodoxa H.B.K. Nova Gen. et Sp. I: 305. 1816, et auct.; non Willd. (1807).

Solitary, erect, large, pleioanthic, monoecious palms; leaf blades paripinnate; sheaths tubular, forming a prominent crownshaft; pinnae acute, 1-ribbed, reduplicate at insertion; inflorescences infraxillary, paniculate, with a prophyll and a large caducous peduncular bract that encloses the inflorescence in bud; flowers borne in triads of 2 staminate and a pistillate or only staminate distally; staminate flowers with 3 briefly imbricate sepals, 3 valvate petals, 6 (-9?) stamens, and short pistillode; pistillate flowers with 3 imbricate sepals, 3 petals connate basally and valvate above, staminodes connate in a tube, and unilocular, uniovulate ovary; fruit ellipsoid to subglobose, with basal stigmatic residue; seed with homogeneous endosperm and basal embryo.

TYPE SPECIES: *Roystonea regia* (H.B.K.) O.F. Cook (*Oreodoxa regia* H.B.K.).

DISTRIBUTION: Southern Florida and Bahama Islands to Trinidad, Venezuela, Mexico, and Honduras. Two species are cultivated in Fiji.

USEFUL TREATMENT OF GENUS: L.H. Bailey in Gentes Herb. 3: 343. 1935.

KEY TO SPECIES

Pinnae in central part of leaf borne in a single rank on each side of rachis; rachillae undulate in bud and at anthesis; fruit nearly twice as long as wide. 1. *R. oleracea*

Pinnae in central part of leaf borne in 2 ranks on each side of rachis; rachillae straight in bud and at anthesis; fruit not much longer than wide. 2. *R. regia*

1. *Roystonea oleracea* (Jacq.) O.F. Cook in Bull. Torrey Bot. Club 28: 554. 1901; L.H. Bailey in Gentes Herb. 3: 364. t. 191-195, 197, 199c, 200a, 202, 203c, 204. 1935; J.W. Parham, Pl. Fiji Isl. ed. 2. 373. 1972.

Areca oleracea Jacq. Select. Stirp. Amer. 278. t. 170. 1763.

Oreodoxa oleracea Mart. Hist. Nat. Palm. 3: 166. t. 156, fig. 1, 2; t. 163. 1837; J.W. Parham in Agr. J. Dept. Agr. Fiji 19: 93. fig. 4. 1948, in op. cit. 29: 33. 1959, Pl. Fiji Isl. 276. 1964.

Trunk stout, gray, to 40 m. high and 40-60 cm. in diameter or more, usually tapered from an enlarged base; leaves to 7 m. long above a green crownshaft to 5 m. high; pinnae 100 or more on each side, borne in a single plane, to 1 m. long; inflorescence usually 3-times branched, with undulate rachillae; fruit purplish to black, 15-20 mm. long, 8-10 mm. in diameter.

TYPIFICATION: In the apparent absence of a type specimen, t. 170 in Select. Stirp. Amer. may be taken as the type.

DISTRIBUTION: Barbados, Tobago, Trinidad, and Venezuela; cultivated elsewhere. Parham indicates that this species is not commonly cultivated in Fiji, although there is a fine specimen in the Suva Botanical Gardens. No Fijian herbarium specimens are available.

LOCAL NAME AND USES: *Cabbage palm*. Ornamental; the central leaves are edible, and in the West Indies the species is cultivated, more commonly for the fruit, which is used as food for pigs.

2. *Roystonea regia* (H.B.K.) O.F. Cook in Science II. 12: 479. 1900; L.H. Bailey in Gentes Herb. 3: 370. t. 199, 200b, c, 202, 203a, 205, 206, 207a, b, 208, 209, 226. 1935; J.W. Parham, Pl. Fiji Isl. ed. 2. 373. 1972.

Oreodoxa regia H.B.K. Nova Gen. et Sp. I: 305. 1816; J.W. Parham in Agr. J. Dept. Agr. Fiji 19: 93. 1948, in op. cit. 29: 33. 1959, Pl. Fiji Isl. 276. 1964.

Trunk stout, to 25 m. high or more, usually thickened centrally; pinnae borne in 2 ranks on each side of rachis, usually less than 1 m. long; inflorescence usually only twice-branched, with straight rachillae; fruit dull red to purplish, 8-13 mm. long, 8-10 mm. in diameter.

TYPEFICTION: The holotype is *Humboldt & Bonpland 1276* (P-HUMB).

DISTRIBUTION: Cuba, but perhaps also Florida and Mexico, and if identical with Florida material then to be called *Roystonea elata* (Bartram) F. Harper. Widely cultivated in warm regions, including Fiji, where it is commonly grown in avenues. Parham notes that there are many fine specimens in the Suva Botanical Gardens and on Government House grounds. No Fijian herbarium material has been seen.

LOCAL NAME AND USE: *Royal palm*; a highly ornamental plant.

13. *CHRYSLIDOCARPUS* H. Wendl. in Bot. Zeitung 36: 117. 1878.

Solitary or cespitose, erect, pleioanthic, monoecious palms; leaf blades paripinnate; sheaths not forming a prominent crownshaft; pinnae acute, 1-ribbed, reduplicate at insertion; inflorescence interfoliar, at least in bud, paniculate, the peduncular bract longer than the prophyll, enclosing the inflorescence in bud, caducous at anthesis; flowers borne in triads of 2 staminate and a pistillate or only staminate distally; staminate flowers with 3 imbricate sepals, 3 valvate petals, 6 stamens with filaments inflexed at the apex in bud, and columnar or ovoid pistillode; pistillate flowers with sepals and petals 3, imbricate, minute staminodes, and trilobular, uniovulate ovary; fruit with basal stigmatic residue; seed with homogeneous endosperm.

TYPE SPECIES: *Chrysalidocarpus lutescens* H. Wendl., the only original species.

DISTRIBUTION: About 20 species in Madagascar, the Comoro Islands, and Pemba. Three species are often cultivated, one in Fiji.

USEFUL TREATMENTS OF GENUS: Beccari, *Palme Madagascar*, 37. 1914; Jumelle & Perrier de la Bathie in Humbert, *Fl. Madagascar et Comores*, Fam. 30: 92. 1945; Beccari & Pichi-Sermolli in Webbia 11: 150. 1955.

1. *Chrysalidocarpus lutescens* H. Wendl. in Bot. Zeitung 36: 117. 1878; J. W. Parham in Agr. J. Dept. Agr. Fiji 19: 92. fig. 3. 1948, in op. cit. 29: 32. 1959, Pl. Fiji Isl. 272. 1964, ed. 2. 369. 1972.

Stems cespitose, to 12 m. high and 12 cm. in diameter; leaves with regularly arranged pinnae more or less ascending from a somewhat arcuate rachis, the sheath and petiole tinged orange-yellow; inflorescence about 80 cm. long; flowers small, yellow-green; fruit ovoid, yellow, 15–21 mm. long, 10–12 mm. in diameter.

TYPEFICTION: A holotype was not designated but may be sought in the Wendl. herbarium (GOET).

DISTRIBUTION: Littoral forests of northeastern Madagascar, but cultivated as an ornamental nearly throughout the tropics.

LOCAL NAME AND USE: *Golden cane palm*; moderately common in Fiji as an ornamental.

AVAILABLE COLLECTIONS: VITI LEVU: SERUA: Ndeumba, DA 17202. NAITASIRI: Toninaiwau, Tholohi-suva, DA 16754.

14. *ARCHONTOPHOENIX* H. Wendl. & Drude in Linnaea 39: 182, 211. 1875.

Loroma O. F. Cook in J. Wash. Acad. Sci. 5: 117. 1915.

Solitary, erect, pleioanthic, monoecious palms; leaves paripinnate; sheaths tubular, forming a prominent crownshaft; pinnae acute, 1-ribbed, reduplicate at insertion; inflorescence infrafoliar, paniculate, short-pedunculate, with a prophyll and a tubular included peduncular bract enclosing the inflorescence in bud, both bracts caducous; flowers borne in triads of 2 staminate and a pistillate, or only staminate distally; staminate flowers somewhat asymmetrical, with 3 imbricate, acutish sepals, 3 valvate petals, (8–) 12–16 (–24) stamens with subulate filaments not inflexed at apex in bud, and narrowly cylindrical pistillode; pistillate flowers with 3 imbricate

sepals, 3 imbricate petals, 3 small staminodes, and a unilocular, uniovulate ovary; fruit ellipsoid to nearly globose, with apical stigmatic residue; mesocarp with prominent flattish fibers appressed to the thin, nonoperculate endocarp; seed with ruminate endosperm and basal embryo.

LECTOTYPE SPECIES: *Archontophoenix alexandrae* (F. v. Muell.) H. Wendl. & Drude (*Ptychosperma alexandrae* F. v. Muell.) (vide O. F. Cook in J. Wash. Acad. Sci. 5: 117. 1915; Pichi-Sermolli in Webbia 11: 63–64. 1955).

DISTRIBUTION: Eastern Australia from New South Wales to Queensland; two species are usually recognized, one being cultivated in Fiji.

USEFUL TREATMENTS OF GENUS: L. H. Bailey in Gentes Herb. 3: 391. 1935; Beccari & Pichi-Sermolli in Webbia 11: 62. 1955.

1. **Archontophoenix alexandrae** (F. v. Muell.) H. Wendl. & Drude in Linnaea 39: 212. 1875; J. W. Parham, Pl. Fiji Isl. ed. 2. 367. 1972.

Ptychosperma alexandrae F. v. Muell. Fragm. Phyt. Austral. 5: 47. t. 43, 44. 1865.

Archontophoenix alexandrae var. *schizantha* H. Wendl. & Drude in Linnaea 39: 212. t. 3, fig. 6. 1875. *Jessenia glazioviana* Dammer in Bot. Jahrb. 31: Beibl. 70: 21. 1902.

Trunk gray, to about 30 m. high and 17 cm. in diameter; leaves about 10, about 2.5 m. long; sheath green; pinnae about 80 on each side, regularly arranged, pale beneath, to 80 cm. long and 5 cm. wide; inflorescence white, with pendulous rachillae to the fourth order and to 70 cm. long or more; staminate flowers white or cream-colored, 5–6 mm. long, with 9–16 stamens; fruit red, 10–14 mm. long, 8–11 mm. in diameter.

TYPIFICATION: The holotype of *Ptychosperma alexandrae* is *Bowman s. n.* (MEL), from Fitzroy's River, Queensland. *Archontophoenix alexandrae* var. *schizantha* is typified by Linnaea 39: t. 3, fig. 6. The type of *Jessenia glazioviana* was *Glaziou 25537* (B), probably now destroyed.

DISTRIBUTION: Queensland; cultivated elsewhere. Parham indicates that there is one plant at the Fiji School of Agriculture, Koronivia, Naitasiri Province, Viti Levu; no herbarium voucher is available.

USE: Ornamental.

15. **VEITCHIA** H. Wendl. in Seem. Fl. Vit. 270. 1868, emend. Becc. in Palme Nuova Caledonia, 8. 1920, in Webbia 5: 76. 1921, in op. cit. 11: 99. 1955; A. C. Sm. in J. Arnold Arb. 36: 275. 1955; H. E. Moore in Gentes Herb. 8: 483. 1957. Nom. cons.

Ptychosperma sensu Seem. Fl. Vit. 272, p. p. 1868; non Labill.

Vitiphoenix Becc. in Ann. Jard. Bot. Buitenzorg 2: 91. 1885; Burret in Repert. Sp. Nov. 24: 282. 1928; A. C. Sm. in J. Arnold Arb. 36: 275. 1955; Becc. & Pichi-Serm. in Webbia 11: 97. 1955.

Adonidia Becc. in Philipp. J. Sci. 14: 329. 1919.

**Kajewskia* Guillaumin in J. Arnold Arb. 13: 113. fig. 2. 1932.

Vitiphoenix subgen. *Acmophoenix* Burret in Occas. Pap. Bishop Mus. 11(4): 8. 1935; Becc. & Pichi-Serm. in Webbia 11: 97. 1955.

Vitiphoenix subgen. *Euvitiphoenix* Burret in Occas. Pap. Bishop Mus. 11(4): 7. 1935; Becc. & Pichi-Serm. in Webbia 11: 97. 1955.

Solitary, erect, pleonanthic, monoecious palms; leaf blades paripinnate; sheaths tubular, forming a prominent crownshaft; pinnae toothed and obliquely truncate to acuminate at apex, reduplicate at insertion; inflorescences infrapetiolate, paniculate; prophyll enclosing the peduncular bract and inflorescence in bud, both bracts caducous before anthesis; flowers borne in spirally arranged triads of 2 staminate and a pistillate basally on the rachillae or staminate only distally; staminate flowers with 3 imbricate sepals, 3 valvate petals, numerous stamens with filaments erect in bud, and lageniform pistillode as long as stamens; pistillate flowers with sepals and

petals 3, imbricate, 3–6 small staminodes, and unilocular, uniovulate ovary; fruit with apical or excentrically apical stigmatic residue, often drying lineolate or pebbled; endocarp not operculate; seed ellipsoid to ovoid, terete in cross section; endosperm homogeneous.

LECTOTYPE SPECIES: *Veitchia joannis* H. Wendl. (vide Becc. & Pichi-Serm. in *Webbia* 11: 101. 1955; Rickett in *Taxon* 10: 122. 1961). Typ. cons. The type species of *Vitiphoenix* is *V. filifera* (H. Wendl.) Becc.; that of *Adonidia* is *A. merrillii* (Becc.) Becc.; and that of *Kajewskia* is *K. aneityensis* Guillaumin.

DISTRIBUTION: New Hebrides, Fiji, and Philippine Islands (Palawan). About 18 species, of which 10 are indigenous to Fiji. The species numbered 7, 8, 9, and 10 in the present treatment are inadequately known and are not included in the following key.

USEFUL TREATMENT OF GENUS: H. E. Moore in *Gentes Herb.* 8: 483. 1957.

KEY TO SPECIES

Fruit less than 2.5 cm. long; stamens 24–52.

Outermost fibers of mesocarp slender, elongate, often running the entire length of seed, the fruit appearing lineolate when dry.

Petals of pistillate flowers 8 mm. wide or less in fruit; fruit usually more than twice as long as wide.

1. *V. vitiensis*

Petals of pistillate flowers 10–13 mm. wide in fruit; fruit less than twice as long as wide.

2. *V. simulans*

Outermost fibers of mesocarp short, thickened, the fruit appearing pebbled when dry.

Panicle persistently and minutely brown-lepidote, at least where protected on major axes; fruit 16–22 mm. long.

Pinnae regularly and closely placed throughout, the lower ones neither separated nor reflexed near base nor (apparently) with persistent lorae; apex of leaf rachis lax but not arcuately recurved.

3. *V. petiolata*

Pinnae not regularly placed throughout, the lower ones separated by intervals of 10–23 cm. and more or less reflexed or pendulous, the lowermost often with persistent chlorophyllous lorae 1–2 m. long; apex of leaf rachis strongly arcuate-recurved.

4. *V. sessilifolia*

Panicle glabrous at anthesis; fruit about 13–15 mm. long.

5. *V. pedionoma*

Fruit 5–6 cm. long; stamens 83–110.

6. *V. joannis*

1. *Veitchia vitiensis* (H. Wendl.) H. E. Moore in *Gentes Herb.* 8: 514. 1957.

Ptychosperma vitiense H. Wendl. ex Seem. in *Bonplandia* 9: 260, as *P. vitiensis*, nom. nud. 1861; Seem.

Viti, 444, as *P. vitiensis*, nom. nud. 1862; H. Wendl. in *Bonplandia* 10: 195. 1862; Seem. *Fl. Vit.* 273. 1868; Drake, Ill. *Fl. Ins. Mar. Pac.* 322. 1892.

Vitiphoenix vitiensis Burret in *Repert. Sp. Nov.* 24: 271, 284. 1928, in *Notizbl. Bot. Gart. Berlin* 12: 599. 1935.

Vitiphoenix smithii Burret in *Occas. Pap. Bishop Mus.* 11 (4): 7. 1935.

Veitchia vitiensis var. *vitiensis*; H. E. Moore in *Gentes Herb.* 8: 516. *fig. 150, Aa–Af.* 1957; J. W. Parham, *Pl. Fiji Isl.* 280. 1964, ed. 2. 375. 1972.

Veitchia vitiensis var. *parhamiorum* H. E. Moore in *Gentes Herb.* 8: 518. *fig. 150, Ag, Ah.* 1957; J. W. Parham, *Pl. Fiji Isl.* 280. 1964, ed. 2. 375. 1972.

Veitchia vitiensis var. *microcarpa* H. E. Moore in *Gentes Herb.* 8: 518. *fig. 150, Ai, Aj.* 1957; J. W. Parham, *Pl. Fiji Isl.* 280. 1964, ed. 2. 375. 1972.

Veitchia smithii H. E. Moore in *Gentes Herb.* 8: 519. *fig. 150, B.* 1957; J. W. Parham, *Pl. Fiji Isl.* 280. 1964, ed. 2. 374. 1972.

Trunk to 16 m. high and 20 cm. in diameter, gray-brown; leaves 2–5 m. long; sheath about 45 cm. long, dark green, mottled with light green; petiole 5–50 cm. long; pinnae 30–50 on each side, glabrous beneath except for red-brown rammenta on midrib and scattered minute brown scales near base, tapered to base and to the obliquely truncate apex from middle, the central pinnae to 45 cm. long and 6.5 cm. wide; inflorescence to 1 m. long, glabrous, the lower branches 2–4-times branched; rachillae slender, 0.7–15 cm. long, with 1–25 flowering nodes; staminate flowers to about 9 mm. long, with 24–32 white stamens; petals of pistillate flowers 8 mm. wide

or less in fruit; fruit red or orange, ovoid to ellipsoid or subglobose, 11–22 mm. long, 5–8 mm. in diameter, drying lineolate over elongate fibers.

TIPIFICATION AND NOMENCLATURE: In 1957 I gave reasons for selecting the BM sheet of *Seemann 662* as the lectotype of *Ptychosperma vitiense*. Wendland originally mentioned this collection as from "Ovalau and Viti Levu", but Seemann (in 1868) indicated that he saw the species at Nukumbalavu. This locality is mentioned by Seemann (Viti, 94, 95, 1862) as the home of a Mr. Work, whom he visited on July 3 and 4, 1860; it lies on the coast of Namosi Province, Viti Levu, opposite the island of Nanggara, and may well be the type locality of the species. *Vitiphoenix smithii* is typified by *Smith 162* (BISH), collected Oct. 16, 1933, in hills above Namalata and Ngaloa Bays, Kandavu. The holotype of *Veitchia vitiensis* var. *parhamiorum* is *H. B. R. Parham s. n.* (BH), collected Aug. 17, 1936, near Tholo-i-suva, Naitasiri Province, Viti Levu; that of *V. vitiensis* var. *microcarpa* is *Smith 9198* (BH), collected Nov. 19, 1953, in hills north of Ngaloa, in drainage of Waininggere Creek, Serua Province, Viti Levu. Study of recent collections suggests that the varieties of *V. vitiensis* previously recognized and *V. smithii* are most satisfactorily treated as components of a somewhat variable species with respect to branching of inflorescence and size of fruit. It is possible that *V. pickeringii* (discussed below as species no. 8) will fall within the limits of *V. vitiensis* when complete material from Ovalau becomes available.

DISTRIBUTION: Endemic to Fiji and known with certainty only from Viti Levu and Kandavu; whether the Ovalau specimens now referred to *Veitchia pickeringii* belong in *V. vitiensis* is a matter for future study. The present species occurs from near sea level to about 900 m. in dense or light forest. At present I refer 15 collections to this species, but two or three others (at SUVA) that I have not seen personally are probably also referable here.

LOCAL NAMES AND USES: *Kaivatu*, *sakiki*, and *niu sakiki* have been recorded by collectors. The stems are said to be used for rafters in house-building; the heart is edible as a salad, and the inflorescence and seed are also said to be edible.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Slopes and ridges of Vuni Marasa on trail from Ndromondromo toward Nandarivatu, *Moore & Koroiveibau 9361*; Vuninatambua, Navai, *Degener 14765*. NANDRONGA & NAVOSA: Nausori Highlands, O. & I. *Degener 31826*. SERUA: Hills east of Navua River, near Nukusere, *Smith 9099*. NAMOSI: Valley of Wainambua Creek, south of Mt. Naitarandamu, *Smith 8808*. NAITASIRI: Matawailevu, on Wainimala River, *DA 18140*; vicinity of Tholo-i-suva, *Setchell & Parks 15121*; water catchment area, Savura Creek, Tamavua, *Moore, Koroiveibau, & Parham 9358*; Savura Creek Reserve, R. & E. F. *Melville & Siwatibau 71/946*. VITI LEVU without further locality, *Seemann 663*, *Parks 20956*.

2. *Veitchia simulans* H. E. Moore in *Gentes Herb.* 8: 506. fig. 148. 1957; J. W. Parham, *Pl. Fiji Isl.* 280. 1964, ed. 2. 374. 1972.

Trunk to 14 m. high, 4–15 cm. in diameter, brown; leaves 2–3 m. long; petiole 15–55 cm. long; sheath very deep green, mottled with gray and pink-brown, 40–50 cm. long; pinnae 15–43 on each side, narrowed above middle to an oblique, toothed, acuminate tip, to 60 cm. long and 55 cm. wide, the midrib, veins, and often the surface beneath lepidote with minute red-brown scales, the ramenta shining, castaneous, basifixed, twisted, near base of pinnae beneath or lacking; inflorescence 50–55 cm. long, 3-times branched into short, strongly flexuous, glabrous rachillae to 11 cm. long; staminate buds about 6 mm. long, with 48–52 stamens, the anthers deeply bifid at apex; pistillate petals 10–13 mm. wide in fruit; fruit orange or red, 20–25 mm. long, 12–18 mm. in diameter; seed ovoid, pointed.

TYPEFICTION: The holotype is *Smith 8158* (BH), collected Aug. 3, 1953, on slopes of Mt. Manuka, Taveuni.

DISTRIBUTION: Endemic to Fiji and thus far known only from Taveuni, where it occurs in dense forest at elevations of (90-) 300-600 m.

LOCAL NAME: *Niusawa*, recorded only from the type collection.

AVAILABLE COLLECTIONS: TAVEUNI: Track to the crater lake east of Somosomo, *DA 14087, 17128, Moore & Koroiveibau 9352*; above Nggathavulo Estate, *DA 16907*. TAVEUNI without further locality, *Thurston s. n.*

3. *Veitchia petiolata* (Burret) H. E. Moore in *Gentes Herb.* 8: 520. *fig. 150, D.* 1957; J. W. Parham, *Pl. Fiji Isl.* 278. 1964, ed. 2. 374. 1972.

Vitiphoenix petiolata Burret in *Occas. Pap. Bishop Mus.* 11 (4): 8. 1935.

Trunk to 35 m. high; petiole about 25 cm. long or more; pinnae about 40 on each side, closely placed, tapered from the middle to the base and to the oblique apex, glabrous beneath except for brown ramenta on the midrib basally and brown scales on the margins, to 55 cm. long and 4 cm. wide; inflorescence 3-times branched, minutely brown-lepidote; rachillae 8.5-13 cm. long, with 18-27 flowering nodes; staminate flowers white, 7 mm. high, with 48-50 stamens; fruit 16-19 mm. long, about 6 mm. in diameter, drying pebbled.

TYPEFICTION: The holotype is *Smith 1687* (BISH), collected Apr. 28, 1934, on the southern slope of Mt. Seatura, Mbua Province, Vanua Levu.

DISTRIBUTION: Known only from the type collection, obtained in dense forest at about 500 m. altitude.

LOCAL NAME: *Niuniu*.

It seems likely that this species is not truly distinct from *Veitchia sessilifolia*; the differences noted in the key are probably subject to variation, even within a population.

4. *Veitchia sessilifolia* (Burret) H. E. Moore in *Gentes Herb.* 8: 521. *fig. 151.* 1957, in *Principes* 2: 33. *fig. 25.* 1958; J. W. Parham, *Pl. Fiji Isl.* 279. 1964, ed. 2. 374. 1972. FIGURE 82.

Vitiphoenix sessilifolia Burret in *Occas. Pap. Bishop Mus.* 11 (4): 9. 1935.

Trunk to 10 m. high and 11 cm. in diameter, gray-brown; leaves to 3.5 m. long; sheath dark green with blackish and white-floccose scales; petiole 10-26 cm. long or more; pinnae 30-47 on each side, glabrous beneath except for ramenta and minute brown scales basally, the lower ones separated at intervals of 10-23 cm. and the lowermost often continued in a slender lora, the others tapered from middle to base and usually to the oblique apex, to 82 cm. long and 5.8 cm. wide; inflorescence to 1.1 m. long, 3- or 4-times branched, densely brown-lepidote; rachillae not flexuous, 5-16 cm. long, with 5-17 flowering nodes; staminate flowers creamy-white, 6-9 mm. long, with 40-48 white stamens; fruit dull orange to red, oblong-ellipsoid, 16-22 mm. long, 8-11 mm. in diameter.

TYPEFICTION: The holotype is *Smith 1784* (BISH), collected May 10, 1934, on Mt. Kasi, Yanawai River region, Thakaundrove Province, Vanua Levu.

DISTRIBUTION: Endemic to Fiji and thus far known only from Vanua Levu, occurring in dense forest at elevations of 120-430 m.

LOCAL NAME AND USE: *Niuniu*; the trunk wood is said to be used for spears.

AVAILABLE COLLECTIONS: VANUA LEVU: THAKAUNDROVE: Eastern drainage of Yanawai River, *Degener & Ordóñez 14074*; near Navonu, Natewa Peninsula, *Moore, Kitone, & Koroiveibau 9348*.

CULTIVATED from seeds of type collection: CUBA: Atkins Garden and Research Laboratory of Harvard University, Soledad, Cienfuegos, *Moore 6087, 6087 bis.* UNITED STATES: FLORIDA: Montgomery Palmetum, Coconut Grove, *Moore 7448*.



FIGURE 82. *Veitchia sessilifolia*, from Moore, Kitone, & Koroiveibau 9348; portion of trunk with inflorescences. Photograph by H. E. Moore, Jr.

5. *Veitchia pedionoma* (A. C. Sm.) H. E. Moore in *Gentes Herb.* 8: 524. fig. 150, C. 152. 1957; J. W. Parham, *Pl. Fiji Isl.* 278. 1964, ed. 2. 374. 1972. FIGURE 83. *Vitiphoenix pedionoma* A. C. Sm. in *J. Arnold Arb.* 31: 145. 1950.

Trunk to 10 m. high and 20 cm. in diameter; leaves about 4 m. long, strongly arcuate apically; sheath elongate; petiole 40–60 cm. long; pinnae 37–50 on each side, crowded toward apex, tapered from middle to base and to the oblique apex, to 75 cm. long and 5.5 cm. wide, the lowest often prolonged in a lora, glabrous beneath except for ramenta near base; inflorescence 60 cm. long and wide, glabrous; rachillae 6–15 cm. long, with 12–25 flowering nodes; staminate flowers white, 7–8 mm. long, with 30–36 stamens; fruit ellipsoid, bright orange to red, 13–15 mm. long, 6–7 mm. in diameter, pebbled when dry.

TIPIFICATION: The holotype is *Smith 6635* (A), collected Nov. 25, 1947, on the Seanggangga Plateau in drainage of Korovuli River, vicinity of Natua, Mathuata Province, Vanua Levu.

DISTRIBUTION: Endemic to Fiji and thus far known only from Vanua Levu, occurring at elevations of 100–500 m. in forest or in patches of forest in open rolling country.

LOCAL NAME AND USES: *Niumiu*; the immature fruit is said to be edible, the leaves are used for thatch, and wood from the stems is used to make canoe ribs and ceremonial spears.

AVAILABLE COLLECTIONS: VANUA LEVU: MATHUATA: Seanggangga Plateau, *DA 11485*. THAKAU-NDROVE: Latiki, on track to Mt. Soro Levu, *DA 17177*.



FIGURE 83. *Veitchia pedionoma*, from Smith 6635; flowering (left) and fruiting (right) inflorescences.

Veitchia pedionoma much resembles *V. sessilifolia* and *V. filifera* in leaf, differing chiefly in the glabrous inflorescence.

6. *Veitchia joannis* H. Wendl. in Seem. Fl. Vit. 271. 1868; H. Wendl. in Gard. Chron. II. 20: 205. fig. 32. 1883; Drake, Ill. Fl. Ins. Mar. Pac. 322. 1892; Burret in Occas. Pap. Bishop Mus. 11 (4): 4. 1935; Becc. & Pichi-Serm. in Webbia 11: 100. fig. 27. 1955; A. C. Sm. in J. Arnold Arb. 36: 275. 1955; H. E. Moore in Gentes Herb. 8: 509. fig. 149. 1957, in Principes 2: 25. fig. 22. 1958; J. W. Parham, Pl. Fiji Isl. 278. 1964, ed. 2. 374. 1972.

Kentia joannis F. v. Muell. Fragm. Phyt. Austral. 7: 101. 1870.

Kentia jipan Hort. in Rev. Hort. 55: 206, 344, pro syn. 1883.

Trunk to 32 m. high and 35 cm. in diameter, gray-brown, usually somewhat thickened at base; leaves to 5 m. long; sheath green with gray tomentum, 60–120 cm. long; petiole 10–30 cm. long; pinnae 70–103 on each side, more or less pendulous, tapered to each end, closely placed at intervals of 0.7–6 cm., to 93 cm. long and 4–8 cm. wide, glabrous beneath except for brown rammenta and a few smaller scales near the base; inflorescence 50–60 cm. long, greenish with brown tomentum, the rachillae flexuous, bearing pistillate flowers at the lowermost 2 or 3 (–6) nodes only; staminate flowers greenish ivory, 1.5–1.7 cm. long, with 83–110 white stamens; fruit orange-red to crimson at maturity, 5–6 cm. long, 2.2–3 cm. in diameter; seed pointed.

TIPIFICATION: The holotype, *Seemann s. n.*, consisted of fruits only, which were erroneously attributed to *Clinostigma exorrhizum* (as *Kentia exorrhiza*) by Wendl. in Bonplandia 10: 191. 1862. It has not been located at Kew and may be represented by fruits sent to Beccari by Seemann now at FI (Hb. Becc.). The locality cited

in *Flora Vitiensis* is "Moturike (i. e. Moturiki), Viti Levu, and Ovalau."

DISTRIBUTION: Endemic to Fiji and known from several islands, although I have seen no material from Ovalau or Moturiki. It occurs in dense or open forest at elevations from near sea level to 650 m. It is cultivated in several countries outside of Fiji.

LOCAL NAMES AND USES: *Niusawa*; *niuniu*; *sanggiwa*. The leaves have been used for thatch and the trunk for spars, construction purposes, and in strips for making bows and arrows. The seeds are said to be edible, as is the "cabbage."

AVAILABLE COLLECTIONS: VITI LEVU: SERUA: Mt. Nggamu, vicinity of Ngaloa, *Degener 15102*. NAITASIRI: Plant Introduction Station, Nanduruloulou, cultivated, *Cooper s. n.* TAILEVU: Verata road, *DA 9166*. REWA: Near Botanical Station (i. e. present Suva Botanical Gardens), *Yeoward s. n.* VANUA LEVU: THAKAUNDROVE: Southern slope of Korotini Range, below Navitho Pass, *Smith 575*; near Navonu, Natewa Peninsula, *Moore, Kititone, & Koroiveibau 9349*. TAVEUNI: Rocky slopes of low hill near Kumbeku, Vuna, south end of island, *Moore, Koroiveibau, & Waibuta 9351*. MATUKU: In valleys and on ridges, *Bryan 294*. VANUA MBALAVU: Slopes of Korolevu, near Lomaloma, *Garnock-Jones 1026*. FIJI without further locality, *Thurston s. n.* CULTIVATED collections are available from gardens in Brazil, Guyana, the Bahamas, and Florida (cf. H. E. Moore in *Gentes Herb.* **8**: 512. 1957).

7. *Veitchia filifera* (H. Wendl.) H. E. Moore in *Gentes Herb.* **8**: 533. 1957; J. W. Parham, *Pl. Fiji Isl.* 278. 1964, ed. 2. 374. 1972.

Arecacea Seem. in *Bonplandia* **9**: 260. 1861.

Ptychosperma filiferum H. Wendl. in *Bonplandia* **10**: 195. 1862; Seem. *Viti*, 367, 371, 444. 1862; H. Wendl. in Seem. *Fl. Vit.* 273. 1868; Drake, *Ill. Fl. Ins. Mar. Pac.* 322. 1892.

Drymophloeus filifera Scheff. in *Ann. Jard. Bot. Buitenzorg* **1**: 158. 1876.

Vitiphoenix filifera Becc. in *Ann. Jard. Bot. Buitenzorg* **2**: 91, 126. 1885; Burret in *Repert. Sp. Nov.* **24**: 270, 283. 1928; Becc. & Pichi-Serm. in *Webbia* **11**: 98, fig. 26. 1955.

Trunks to about 10 m. high and 13 cm. in diameter; leaves 3–4 m. long, the pinnae elongate-lanceolate, coriaceous, sharply toothed-acuminate at apex with the upper side produced beyond the lower, glabrous beneath except for brown ramenta on midrib at base, to 60 cm. long and 6 cm. wide, 8 cm. apart, the lowermost ones prolonged in a slender lora.

TYPEFICTION: In the original publication Wendland states "N. Vanua Levu near Bikana, Seemann 661." No such locality is noted on modern maps, but there is a Mbekana Island off the north coast of Vanua Levu about 22 kilometers west of Undu Point. Seemann passed along this coast October 15–16, 1860 (*Viti*, p. 229); in *Viti* he mentions no shore stops after leaving Namuka, but it is very likely that the *Paul Jones* (the small ship in which Seemann made many excursions with W. T. Pritchard, then British Consul) anchored in the protection of Mbekana Island for the night of Oct. 15. That evening a trip was made to the mainland (*Flora Vitiensis*, p. 273). The holotype of this species may therefore be considered *Seemann 661* (κ), collected Oct. 15, 1860, in Mathuata Province opposite Mbekana Island, Vanua Levu.

DISTRIBUTION: Known with certainty only from the type collection.

LOCAL NAMES AND USE: *Thangithake*, *niuniu* (more or less generic names, mentioned by Seemann); Parham adds the names *nesi* and *thangithangi* for this species, but perhaps they are also generic in nature. Seemann indicates that the trunks are used for rafters, but again this would be true of any species of *Veitchia* in Fiji.

Veitchia filifera very much resembles *V. pedionoma* and *V. sessilifolia* in its leaf. Lacking specimens of inflorescence and fruit, it cannot be definitely placed, but almost certainly it represents one of these more recently described species. In 1957 (cited above) I suggested that the fruits of two species were erroneously associated

with *Seemann 661*; until adequate topotypic material is obtained the precise identity of *V. filifera* must remain in doubt.

8. *Veitchia pickeringii* (H. Wendl.) H. E. Moore in *Gentes Herb.* 8: 534. fig. 150, *E.* 1957; J. W. Parham, *Pl. Fiji Isl.* 278. 1964, ed. 2. 374. 1972.

Ptychosperma pickeringii H. Wendl. in *Bonplandia* 10: 194, as *P. pikerinii*. 1862; Seem. *Viti*, 444. 1862, *Fl. Vit.* 273. 1868; Drake, *Ill. Fl. Ins. Mar. Pac.* 322. 1892.

Vitiphoenix pickeringii Burret in *Repert. Sp. Nov.* 24: 270, 284. 1928, in *Notizbl. Bot. Gart. Berlin* 12: 598. 1935.

Balaka spectabilis Burret in *Bishop Mus. Bull.* 141: 13. 1936; J. W. Parham, *Pl. Fiji Isl.* 272. 1964, ed. 2. 368. 1972.

Trunk to 10 m. high and 15 cm. in diameter; leaves 4–5 m. long; petiole about 50 cm. long; pinnae about 40 on each side, 3.5–4.5 cm. apart at midleaf, to 50 cm. long and 7 cm. wide, tapered from the middle to base and to the oblique apex, glabrous beneath except for ramenta and minute red-brown scales basally; inflorescence 3-times branched, glabrous; rachillae 5–16 cm. long, with 9 or 10 flowering nodes; staminate flowers greenish white, 7–8 mm. long; stamens 20–28.

TIPIFICATION AND NOMENCLATURE: As lectotype of *Ptychosperma pickeringii* I have in 1957 designated the fragmentary specimen of *U.S. Expl. Exped.* (GH), collected in Ovalau in 1840. Burret had indicated the holotype to be at B; it is now destroyed, and no Exploring Expedition material representing the species has been found at US or K. The GH specimen is annotated by Wendland. The holotype of *Balaka spectabilis* is *Bryan 600* (BISH), collected Oct. 14, 1924, in Ovalau. Both types bear flowers and show no significant differences.

DISTRIBUTION: Endemic to Fiji and known with certainty only from Ovalau.

LOCAL NAME: *Thangithake* (the frequent generic name).

AVAILABLE COLLECTION: OVALAU: Hills east of Lovoni Valley, *Smith 7276*.

Veitchia pickeringii will probably prove synonymous with *V. vitiensis* when fruit is known. All three available specimens from Ovalau are in flower; *Smith 7276* is a good match for the type material of *Balaka spectabilis*.

9. *Veitchia subglobosa* H. Wendl. in *Seem. Fl. Vit.* 272. 1868; Drake, *Ill. Fl. Ins. Mar. Pac.* 322. 1892; H. E. Moore in *Gentes Herb.* 8: 532. 1957; J. W. Parham, *Pl. Fiji Isl.* 280. 1964, ed. 2. 375. 1972.

Kentia subglobosa F. v. Muell. *Fragm. Phyt. Austral.* 7: 101. 1870.

Fruit oblong-ovoid, 4 cm. long, nearly 3 cm. in diameter; seed subglobose, 23 mm. long and nearly as thick; raphe narrow, with few, somewhat anastomosed branches.

TIPIFICATION: The holotype and only known specimen consisted of a single fruit collected in Fiji by Veitch and put out to germinate so that the outer part of the seed, and especially the raphe and its branches, had been injured, according to Wendland. This fruit has not been located at Kew or in the Wendland herbarium at Göttingen.

DISTRIBUTION: Fiji, but not further specified.

The holotype has not been located and material associated with the name by Beccari (cf. H. E. Moore, 1957, cited above) is problematical. It is unlikely that the species will ever be recognized and the name is best consigned to the list of dubious species.

10. *Veitchia* sp.

Material from Taveuni that lacks fruit appears nevertheless to represent the *Veitchia filifera*-*V. petiolata*-*V. sessilifolia* complex on that island. Its status cannot be determined until fruit is known, but it differs from *V. petiolata*, which it generally resembles, in having 60 pinnae on each side of the rachis and staminate flowers with only 26 stamens.

AVAILABLE COLLECTION: TAVEUNI: Slopes along creek in lowland forest, southern end of Salialevu Estate, south end of island, Moore, Koroiveibau, & Waibuta 9350.

16. BALAKA Becc. in Ann. Jard. Bot. Buitenzorg 2: 91. 1885; Burret in Repert. Sp. Nov. 24: 273. 1928; Becc. & Pichi-Serm. in Webbia 11: 106. 1955.

Ptychosperma sensu Seem. Fl. Vit. 272, p. 1868; non Labill.

Solitary, erect, pleonanthic, monoecious palms; leaf blades paripinnate; sheaths tubular, forming a prominent crownshaft; pinnae toothed and oblique to truncate at apex, reduplicate at insertion; inflorescence infrafoliar, paniculate, long-pedunculate, the peduncular bract inserted well above and exceeding prophyll, terete and enclosing inflorescence in bud, both bracts usually caducous before anthesis; flowers borne in distichously arranged triads of 2 staminate and a pistillate, at least basally on the rachillae, staminate only distally; staminate flowers with 3 imbricate sepals, 3 valvate petals, numerous (24-50) stamens with filaments erect in bud, and lageniform pistillode exerted and often more or less flexuous apically at anthesis; pistillate flowers with sepals and petals 3, imbricate, mostly 6 small staminodes, and unilocular, uniovulate ovary; fruit with apical stigmatic residue, drying pebbled over short fibers in the mesocarp; endocarp 4-angled or 4-ridged and crested, not operculate; seed 4-angled in cross section; endosperm homogeneous.

LECTOTYPE SPECIES: *Balaka perbrevis* (H. Wendl.) Becc. (*Ptychosperma perbreve* H. Wendl.) (vide Pichi-Sermolli in Webbia 11: 108. 1955).

DISTRIBUTION: Fiji and Samoa; about seven species, of which five are restricted to Fiji.

KEY TO SPECIES

- Pinnae tapered from middle toward base and apex, elongate-sigmoid in outline, about 5 times as long on midrib as wide at middle.
 Fruit small, 1.8 cm. long, 9 mm. in diameter or less; petals of pistillate flowers 6 mm. long or less in fruit.
 Rachillae 12-23 cm. long, with about 50 flowering nodes; triads borne nearly throughout the rachillae. 1. *B. microcarpa*
 Rachillae 5-9 cm. long, with 5-9 flowering nodes; triads borne at the basal 2-5 nodes only on the rachillae. 2. *B. pauciflora*
 Fruit large, (2.8-) 3.3-4.2 cm. long, 1.5-1.7 cm. in diameter; petals of pistillate flowers 1-1.2 cm. high and 1.3 cm. wide in fruit. 3. *B. macrocarpa*
 Pinnae cuneate to elongate-cuneate, little if at all tapered from middle toward apex, less than 4 times as long as wide at widest point.
 Fruit 1.9 cm. long or less, 5-10 mm. in diameter; endocarp not prominently keeled; petals of pistillate flowers 4-6 mm. long or less in fruit. 4. *B. seemannii*
 Fruit (2.5-) 3.2-3.8 cm. long, 1.1-1.6 cm. in diameter; endocarp strongly and sharply ridged and keeled; petals of pistillate flowers (0.8-) 1-1.4 cm. long and 8 mm. wide in fruit. 5. *B. longirostris*

1. *Balaka microcarpa* Burret in Notizbl. Bot. Gart. Berlin 15: 89. 1940.

Balaka microcarpa var. *longicuspis* Burret in Notizbl. Bot. Gart. Berlin 15: 90. 1940; J. W. Parham, Pl. Fiji Isl. 271. 1964, ed. 2. 368. 1972.

Balaka microcarpa var. *microcarpa*; J. W. Parham, Pl. Fiji Isl. 271. 1964, ed. 2. 368. 1972.

Trunk to 13 m. high and 8 cm. in diameter; leaves 1.5 m. long or more; petiole short; pinnae 12-16 on each side, more or less elongate-sigmoid, narrowed from middle to base and to the toothed apex, to 56 cm. long, 10.5 cm. wide at middle; in-

florescence 2- or 3-times branched; rachillae 12–23 cm. long; flowering nodes 50 or more, distichously arranged, with triads borne nearly to apex; flowers brown-lepidote, the staminate 5 mm. long, red-brown with green calyx, 28–32 stamens, and exserted pistillode light canary-yellow; petals of pistillate flower 4–5 mm. high in fruit; fruit 1.4–1.8 cm. long, 7–9 mm. in diameter.

LECTOTYPIFICATION AND NOMENCLATURE: The holotype of *Balaka microcarpa* was *Meebold 16418*, collected in August, 1932, "9 miles above Suva," i.e. doubtless near Tholo-i-suva in Naitasiri Province, Viti Levu; presumably this specimen was at B on loan from BISH and was destroyed. As lectotype I herewith designate a duplicate deposited at K. The holotype of *B. microcarpa* var. *longicuspis* was a specimen of *Bryan 207*, collected June 21, 1924, near Tholo-i-suva, Naitasiri Province, Viti Levu; probably several sheets of this number were on loan to B from BISH and were destroyed. The implication was that Burret intended to return the holotype to BISH, keeping an isotype at B. Fortunately one sheet of *Bryan 207* remains at BISH, which I herewith designate as the lectotype; isolectotypes are at K and US. The distinctions between the two taxa concerned are not significant.

DISTRIBUTION: Endemic to Fiji and thus far known only from southeastern Viti Levu, where it occurs in often dense forest at elevations of 100–200 m.

AVAILABLE COLLECTIONS: VITI LEVU: NAITASIRI: Tholo-i-suva, *DA 9853*, p. p.; "Central Road," *Tothill 424, 527*; Savura Creek, Tamavua, *Bernardi 12407*, *Moore, Koroiveibau, & Parham 9359*; Savura Creek Reserve, *R. & E. F. Melville & Sivatibau 71/943, 71/947*. TAILEVU: Verata, *DA 9853*, p. p. REWA: Track to Mt. Korombamba, *DA 17213*.

2. *Balaka pauciflora* (H. Wendl.) H. E. Moore in *Gentes Herb.* **8**: 535. 1957; J. W. Parham, *Pl. Fiji Isl.* 271. 1964, ed. 2. 368. 1972.

Ptychosperma pauciflorum H. Wendl. in *Bonplandia* **10**: 193. 1862; Seem. *Viti*, 444. 1862, *Fl. Vit.* 272. 1868; Drake, *Ill. Fl. Ins. Mar. Pac.* 322. 1892.

Vitiphoenix pauciflora Burret in *Repert. Sp. Nov.* **24**: 270, 285. 1928, in *Notizbl. Bot. Gart. Berlin* **12**: 598, 599. 1935.

Drymophloeus pauciflorus Becc. in *Martelli in Atti Soc. Tosc. Sci. Nat. Mem.* **44**: 151. 1934.

Trunk about 2.5 cm. in diameter; pinnae broadly linear, about 5 times as long as wide, narrowed to base and toothed apex from middle; inflorescence with rachillae 5–9 cm. long; flowering nodes 5–9, only the lower 2–5 with triads; petals of pistillate flower 6 mm. high in fruit; fruit 1.5 cm. long, 9 mm. in diameter.

LECTOTYPIFICATION: *Ptychosperma pauciflorum* was typified by a U.S. Exploring Expedition specimen. Burret indicated that he had seen authentic material, presumably at B and now destroyed. In 1957 I designated *U.S. Expl. Exped.* (GH) as the lectotype; it had been annotated by Wendland. The specimen and also a second, seedling specimen bear the usual Exploring Expedition "Feejee Islands" printed labels, but "Upolu" has been written on them. It is probable that Wendland's cited locality of Ovalau is correct, although many of the Exploring Expedition's specimens have scrambled labels. No material corresponding to the description has been found at US or K or in the Wendland herbarium at GOET.

DISTRIBUTION: Known only from the type collection, presumably Ovalau, and therefore endemic to Fiji.

LOCAL NAME AND USE: (From Wendland): *Black bamboo*; used for making spears.

3. *Balaka macrocarpa* Burret in *Occas. Pap. Bishop Mus.* **11** (4): 5. 1935; J. W. Parham, *Pl. Fiji Isl.* 271. 1964, ed. 2. 368. 1972.

Trunk to 8 m. high and 6 cm. in diameter; leaves about 2 m. long; petiole 6–24 cm. long; pinnae elongate-sigmoid, narrowed from middle to base and to the toothed

apex, to 39 cm. long and 6 cm. wide; inflorescence with rachillae to 33 cm. long; flowering nodes (11-) 25-28; staminate flowers lepidote, with numerous stamens; petals of pistillate flower 1-1.2 cm. high in fruit; fruit orange, (2.8-) 3.3-4.2 cm. long, 1.5-1.7 cm. in diameter.

TYPEFICTION: The holotype is *Smith 2007* (BISH), collected June 15, 1934, on Mt. Uluigala, Natewa Peninsula, Thakaundrove Province, Vanua Levu.

DISTRIBUTION: Endemic to Fiji and thus far known from Viti Levu and Vanua Levu, occurring in dense forest at elevations up to 820 m.

LOCAL NAME: *Niuniu*.

AVAILABLE COLLECTIONS: VITI LEVU: NAMOSI: Nambukavesi Creek, *Damanu 94*. VANUA LEVU: THAKAUNDROVE: Track to Mt. Soro Levu, *DA 17134, 17137*.

4. *Balaka seemannii* (H. Wendl.) Becc. in Ann. Jard. Bot. Buitenzorg **2**: 91. 1885; Burret in Repert. Sp. Nov. **24**: 270, 273. 1928, in Notizbl. Bot. Gart. Berlin **12**: 599, 600. 1935; H. E. Moore in Gentes Herb. **8**: 536. 1957; J. W. Parham, Pl. Fiji Isl. 272, as *B. seemanni*, 1964, ed. 2. 368, as *B. seemanni*. 1972.

Ptychosperma seemannii H. Wendl. ex Seem. in Bonplandia **9**: 261, nom. nud. 1861; H. Wendl. in Bonplandia **10**: 192. 1862; Seem. Viti, 367, 373, 444. 1862, Fl. Vit. 272, t. 82. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 322. 1892.

Ptychosperma perbreve H. Wendl. in Bonplandia **10**: 193. 1862; Seem. Viti, 444. 1862, Fl. Vit. 272. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 322. 1892.

Balaka perbrevis Becc. in Ann. Jard. Bot. Buitenzorg **2**: 91. 1885, in Webbia **4**: 154. 1913; Burret in Repert. Sp. Nov. **24**: 270, 274. 1928; Becc. & Pichi-Serm. in Webbia **11**: 107. fig. 30. 1955; J. W. Parham, Pl. Fiji Isl. 271. 1964, ed. 2. 368. 1972.

Kentia kersteniana Hort. sensu Becc. in Webbia **4**: 154. 1913; non Hort. ex Sander.

Balaka gracilis Burret in Repert. Sp. Nov. **24**: 274. 1928; J. W. Parham, Pl. Fiji Isl. 271. 1964, ed. 2. 367. 1972.

Drymophloeus seemannii Becc. ex Martelli in Nuovo Giorn. Bot. Ital. II. **42**: 79. 1935.

Vitiphoenix seemanni Becc. ex Martelli in Nuovo Giorn. Bot. Ital. II. **42**: 87, pro syn. 1935.

Balaka cuneata Burret in Occas. Pap. Bishop Mus. **11** (4): 6. 1935; J. W. Parham, Pl. Fiji Isl. ed. 2. 367. 1972.

Trunk to 8 m. high and 5 cm. in diameter; leaves to 2 m. long; petiole 10-25 cm. long; pinnae 10-12 on each side, praemorse-cuneate, to 23 cm. long and 10 cm. across apex; inflorescence 1- or 2-times branched; rachillae 3.5-23 cm. long; flowering nodes 10-49; staminate flowers glabrescent to lepidote, 5-6 mm. long; stamens 21-29; petals of pistillate flowers 4-6 mm. long in fruit; fruit red, 1.4-1.9 cm. long, 5-10 mm. in diameter; endocarp thin, ridged and sculptured but not prominently keeled.

TYPEFICTION AND NOMENCLATURE: Four basionyms are concerned in the synonymy of this species, among which differences seem fairly inconsequential. The holotype of *Ptychosperma seemanni* is *Seemann 664* (κ, 2 sheets). Wendland indicated this material coming from "Vanua Levu and N. Taveuni," but of the two sheets one is indicated as "Vuna June 1860" (Seemann often using Vuna incorrectly to designate the entire island of Taveuni), and the other bears no locality data. I believe that they may be taken together as comprising the holotype. *Ptychosperma perbreve* was based by Wendland on U.S. Exploring Expedition material said to come from "N. Vanua Levu, & Sandalwood Bay"; Seemann implied that two specimens were involved, one coming from Mbua or Sandalwood Bay (Mbua Province) and the other from the Mathuata (Province) coast, Vanua Levu. No such material has been located at US or κ, however, and I herewith designate *U.S. Expl. Exped.* (GH), annotated by Wendland, as the lectotype; no precise locality is indicated on this specimen. The holotype of *Balaka gracilis* was *Weber 113* (B), collected in November, 1881, on the northwestern coast of Taveuni; the specimen is presumably

destroyed and no duplicates are known to me. The holotype of *Balaka cuneata* is Smith 577 (BISH), collected Nov. 24, 1933, in hills between the Vatukawa and Wainio Rivers, Ndrekeniwai Valley, Thakaundrove Province, Vanua Levu.

DISTRIBUTION: Endemic to Fiji and thus far known only from Vanua Levu and Taveuni, where it occurs with some frequency in various types of forest at elevations from near sea level to 1,000 m. In addition to the types cited above, some 34 collections are available; however, these include several DA collections at SUVA so referred by A. C. Smith but not seen by me. Below I list only those specimens I have studied.

LOCAL NAMES AND USES: The most frequent name for this species, as in fact for all Fijian members of the genus, is *mbalaka*; also recorded have been *niuniu*, *niu mbalaka*, and *mbelako*. The very straight stems are used for walking sticks and spears, and the immature fruit is said to be edible. Parham indicates that the species is widely used as an ornamental both in Fiji and elsewhere.

REPRESENTATIVE COLLECTIONS: VANUA LEVU: MATHUATA: Seanggangga Plateau, in drainage of Korovuli River and in vicinity of Natua, Smith 6674, DA 12857, 12879, 16670; vicinity of Lambasa, Greenwood 605; Mt. Numbuiloa, east of Lambasa, Smith 6334. THAKAUNDROVE: Eastern drainage of Yanawai River, Degener & Ordenez 14075; vicinity of Savusavu, DA 17513; Latiki, track to Mt. Soro Levu, DA 17163, 17166, 17167, 17170, 17171, 17173, 17175, 17179; hills south of Natewa, Natewa Peninsula, Smith 1950. TAVEUNI: Middle slopes of mountain along trail to lake east of Somosomo, Moore & Koroiveibau 9356, DA L.26190.

5. *Balaka longirostris* Becc. in Webbia 4: 270. fig. 24. 1914; Burret in Repert. Sp. Nov. 24: 277. 1928, in Occas. Pap. Bishop Mus. 11 (4): 5. 1935; J. W. Parham, Pl. Fiji Isl. 271. 1964, ed. 2. 368. 1972.

Balaka leprosa A. C. Sm. in J. Arnold Arb. 31: 146. 1950; J. W. Parham, Pl. Fiji Isl. 271. 1964, ed. 2. 367. 1972.

Trunk to 7 m. high and 5 cm. in diameter; leaves 1–2 m. long; petiole 0.5–26 cm. long; pinnae 7–14 on each side, cuneate, with strongly lobed and toothed, oblique apex, to 27 cm. long, 16 cm. across apex; inflorescence 1- or 2-times branched; rachillae 5–22.5 cm. long; flowering nodes 20–44; staminate flowers 5–7 mm. long, greenish yellow, thinly brown-lepidote, with 25–44 stamens and flexuous pale yellow-white pistillode; petals of pistillate flowers (0.8–) 1–1.4 cm. long in fruit; fruit fusiform-ellipsoid, orange-red, (2.5–) 3.2–3.8 cm. long, 1.1–1.6 cm. in diameter; endocarp thin, sharply ridged and keeled, with rostrum about 10 mm. long.

TYPIFICATION AND NOMENCLATURE: *Balaka longirostris* was described from two fruits only; these comprise the holotype, Yeoward (K), dated April, 1894. Notes on the holotype state: "A palm 40 ft. high, with leaves like *Caryota urens*." "None of these seeds germinated." "106-94 Fiji Bot. Sta. 9-iii-01." From these notes one might assume that Yeoward tried to grow the species in what is now the Suva Botanical Gardens but failed. The holotype of *B. leprosa* is Smith 6219 (A), collected Sept. 25, 1947, in hills east of Nandala Creek, about three miles south of Nandarivatu, Mba Province, Viti Levu. From the ample material now at hand I feel sure that *B. leprosa* may be referred to the synonymy of Beccari's species.

DISTRIBUTION: Endemic to Fiji and thus far known only from Viti Levu, where it occurs in various types of forest at elevations from near sea level to about 1,000 m. In addition to the specimens listed above and below, which I have studied personally, a few others in the DA series at SUVA probably represent the species, according to A. C. Smith.

LOCAL NAMES AND USES: *Mbalaka*; *niuniu*. Ceremonial spears are made from the slender trunk, and the kernel of the seed is said to be edible.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Slopes and ridges of Vunimarasa on trail from Ndromondromo toward Nandarivatu, Moore & Koroiveibau 9362; Mt. Nanggaranambuluta, east of Nandarivatu, DA 14711, 14712; Vuninatambua, Navai, Degener 14764. SERUA: Vicinity of Ngaloa, R. & E. F. Melville & Siwatibau 71/1971; Vatutavathe, near Ngaloa, Degener 15174; inland from Ngaloa, DA 16564; hills between Wainiggere and Waisee Creeks, between Ngaloa and Wainiyambia, Smith 9387. REWA: Veisari River, DA 14713, 14714, 14715.

17. *PTYCHOSPERMA* Labill. in Mém. Cl. Sci. Inst. Nat. France 9: 252. 1809.

Actinophloeus Becc. in Ann. Jard. Bot. Buitenzorg 2: 126. 1885.

Solitary or cespitose, erect, pleonanthic, monoecious palms; leaf blades paripinnate; sheaths tubular and forming a prominent crownshaft; pinnae 1-ribbed, broadest at middle or at apex and there praemorse; inflorescence infrafoliar, paniculate; peduncular bract somewhat longer than prophyll, enclosing inflorescence in bud, caducous before anthesis; flowers borne in triads of 2 staminate and a pistillate or only staminate distally; staminate flowers with 3 imbricate sepals, 3 valvate petals, 9-100 or more stamens with filaments erect in bud, and lageniform or conic-ovoid pistillode; pistillate flowers with 3 imbricate sepals, 3 imbricate petals except valvate tips, minute staminodes, and unilocular, uniovulate ovary; fruit red, orange, or purple-black, with apical stigmatic residue; seed 5-grooved or 5-angled, with homogeneous or ruminate endosperm.

TYPE SPECIES: *Ptychosperma gracile* Labill. (*P. "gracilis"*). The lectotype species of *Actinophloeus* is *A. ambiguus* (Becc.) Becc. (*Drymophloeus ambiguus* Becc.) (vide Burret in Repert. Sp. Nov. 24: 271. 1928).

DISTRIBUTION: Northeastern Australia, New Guinea, Solomon Islands, and Caroline Islands. About 28 species, one of which has been introduced into Fiji.

USEFUL TREATMENTS OF GENUS: Beccari & Pichi-Sermolli in Webbia 11: 87. 1955; Essig in Principes 21: 3. 1977, in Allertonia 1: 415. 1978.

1. *Ptychosperma macarthurii* (H. Wendl. ex Veitch) H. Wendl. ex Hook. f. in Rep. Kew Gard. 1882: 55. 1884; Nicholson, Ill. Dict. Gard. 3: 248. 1886; J. W. Parham, Pl. Fiji Isl. ed. 2. 373, as *P. macarthurii*. 1972; Essig in Allertonia 1: 452. 1978.

Kentia macarthurii H. Wendl. ex Veitch, Catalogue 1879: 26. 1879.

Actinophloeus macarthurii Becc. in Webbia 4: 154. 1913; Burret in Repert. Sp. Nov. 24: 272. 1928;

J. W. Parham in Agr. J. Dept. Agr. Fiji 19: 91. fig. 2. 1948, Pl. Fiji Isl. 271, as *A. macarthurii*. 1964.

Actinophloeus hospitus Burret in Notizbl. Bot. Gart. Berlin 11: 206. 1931.

Ptychosperma julianettii Becc. in Martelli in Atti Soc. Tosc. Sci. Nat. Mem. 44: 32. 1934.

Ptychosperma hospitum Burret in Notizbl. Bot. Gart. Berlin 12: 596. 1935, in op. cit. 15: 91. 1940;

J. W. Parham, Pl. Fiji Isl. ed. 2. 373. 1972.

Stems cespitose or rarely solitary, to 7 m. high, 7 cm. in diameter; leaves to 2 m. long or more; pinnae 23-28 on each side, more or less regularly arranged, obliquely praemorse, with margins nearly parallel or tapered apically; inflorescence to 60 cm. wide; staminate flowers 6-8 mm. long, with 26-40 stamens; fruit red, ovoid, 12-16 mm. long; seed deeply (3-) 5-grooved, with homogeneous endosperm.

TYPIFICATION: No holotype was made from the cultivated material originally described. Essig (1978, cited above) has designated Brass 6376 (A), from New Guinea, as neotype. The holotype of *Actinophloeus hospitus* was a specimen from Hort. Bogor s. n. (V-H-17) at B, now destroyed, but represented by a photograph (BH).

DISTRIBUTION: South-central New Guinea and northeastern Australia; cultivated elsewhere.

LOCAL NAME AND USE: *Cluster palm*; Parham mentions it as a popular ornamental in Fiji. *Ptychosperma hospitum* is considered a synonym by Essig (1978).

AVAILABLE COLLECTION: VITI LEVU: REWA: Naikorokoro Creek, *Meebold 21948*; this specimen, probably taken from an escape from cultivation, was cited by Burret in 1940 as being at B; possibly a duplicate exists in some other herbarium.

18. *ARECA* L. Sp. Pl. 1189. 1753.

Solitary or caespitose, erect, pleonanthic, monoecious palms; leaf blades pinnately ribbed or mostly pinnate; pinnae 1- or several-ribbed, acute or toothed apically, reduplicate at insertion; inflorescences usually infrapetiole, paniculate to spicate, with a caducous prophyll and no peduncular bract; flowers borne in triads of 2 staminate and a pistillate or staminate only distally in spiral arrangement or triads secund at or near base and staminate flowers uniseriately secund or distichous distally; staminate flowers with 3 distinct or connate sepals, 3 valvate petals, and 3-24 stamens; pistillate flowers larger than staminate, with 3 imbricate sepals and petals, minute staminodes, and unilocular, uniovulate ovary; fruit with apical stigmatic residue, fleshy-fibrous; seed with ruminant endosperm.

TYPE SPECIES: *Areca catechu* L. (as *A. cathecu*), the only original species.

DISTRIBUTION: India and Ceylon to Philippine Islands, Indonesia, New Guinea, and Solomon Islands. Probably about 50 species, of which one is cultivated in Fiji.

USEFUL TREATMENTS OF GENUS: Blatter, *Palms Brit. India & Ceylon*, 469. 1926; Furtado in *Repert. Sp. Nov.* 33: 217. 1933; Beccari & Pichi-Sermolli in *Webbia* 11: 28. 1955.

1. *Areca catechu* L. Sp. Pl. 1189, as *A. cathecu*. 1753; J. W. Parham, *Pl. Fiji Isl.* 271. 1964, ed. 2. 367, as *A. cathecu*. 1972.

Stem solitary, green, prominently ringed, to 10 (-30) m. high, 15-20 cm. in diameter; leaves to nearly 2 m. long; pinnae about 12 on each side, usually 2- or 3-ribbed; inflorescence 2- or 3-times branched into divaricate rachillae; staminate flowers distichous distally, about 5 mm. long, the sepals distinct, small, the stamens 6; pistillate flowers 12-15 mm. long, mostly solitary at base of rachilla; fruit oblong to ovoid, dull orange or red, 4-5 cm. long.

LECTOTYPIFICATION: Linnaeus gives several prior references, but I have not noted an adequate lectotypification.

DISTRIBUTION: India and Ceylon to southeastern Asia, Indonesia, and apparently the Philippine Islands; widely cultivated in the Asiatic tropics and nativity not certain.

LOCAL NAMES AND USES: *Areca*; elsewhere the species is commonly known as *betel-nut palm*. In Fiji it was an early introduction and is established in a number of places as an ornamental, although no herbarium vouchers are available. Farther west the species is widely grown for its seeds, which are used as a masticatory with the leaves of *Piper betle* and lime.

Although the epithet was spelled "*cathecu*" in *Species Plantarum*, it appeared as "*catechu*" in the list of *nomina trivialia* and in other Linnaean works. Merrill (*Interpret. Rumph. Herb. Amb.* 123. 1917), H. E. Moore (*in Principes* 3: 47. 1959), and Furtado (*in Principes* 4: 26. 1960) consider *cathecu* an erroneous spelling to be corrected, an opinion reflected on the current ING card.

19. *PINANGA* Bl. in *Bull. Sci. Phys. Nat. Néerl.* 1: 65. 1838.

Solitary or caespitose, erect, pleonanthic, monoecious palms; leaf blades undivided and pinnately ribbed or mostly pinnate; pinnae 1- or several-ribbed, acute or

toothed apically, reduplicate at insertion; inflorescence usually infrafoliar, simply branched or spicate, with a caducous prophyll and no peduncular bract; flowers borne in triads of 2 staminate and a pistillate in 2 or 3 vertical rows or more rarely triads spiralled on the rachillae; staminate flowers acute, asymmetrical, with 3 briefly connate sepals, 3 valvate petals, and 6 or more stamens; pistillate flowers smaller than staminate, with 3 imbricate or connate sepals, 3 imbricate petals, minute staminodes, and unilocular, uniovulate ovary; fruit with apical stigmatic residue, fleshy; seed with ruminant or rarely homogeneous endosperm.

LECTOTYPE SPECIES: *Pinanga coronata* (Bl. ex Mart.) Mart. (vide Pichi-Sermolli in Webbia 11: 31. 1955).

DISTRIBUTION: About 100 species in India and Ceylon to Philippine Islands and New Guinea; cultivated elsewhere. One species is cultivated in Fiji.

USEFUL TREATMENTS OF GENUS: Blume, Rumphia 2: 76. 1838-1839; Beccari, Malesia 3: 110. 1886; Blatter, Palms Brit. India & Ceylon, 460. 1926; Beccari & Pichi-Sermolli in Webbia 11: 29. 1955

1. *Pinanga kuhlii* Bl. Rumphia 2: 82. 1838-1839.

Stems caespitose, to 8 m. high or more, 2.5 cm. in diameter or more; leaves spreading, to 1 m. long or more; pinnae 5 or 6 on each side, mostly 5-7-ribbed, to 45 cm. long and 9 cm. wide; inflorescence simply branched into 7-15 pendulous rachillae to 30 cm. long; triads distichous; staminate flowers pinkish, about 6 mm. long, the stamens about 9; fruit black at maturity, 10-14 mm. long, 7-8 mm. in diameter; seed with ruminant endosperm.

TYPE SPECIES: The holotype is *Blume s. n.* (L.).

DISTRIBUTION: Indonesia; cultivated elsewhere.

USE: Grown as an ornamental.

AVAILABLE COLLECTION: VITI LEVU: NAITASIRI: Iholo-i-suva, cultivated, DA 18579.

20. *Neoveitchia* Becc. Palme Nuova Caledonia, 9. 1920, in Webbia 5: 77. 1921; Lemée, Dict. Descr. Syn. Gen. 4: 712. 1932; Becc. & Pichi-Serm. in Webbia 11: 108. 1955; A. C. Sm. in J. Arnold Arb. 36: 274. 1955; H. E. Moore in Gentes Herb. 8: 537. 1957.

Solitary, erect, pleonanthic, monoecious palms; leaf blades paripinnate; sheaths more or less split on one side, not forming a prominent crownshaft; pinnae 1-ribbed, acute, reduplicate at insertion; inflorescence infrafoliar, short-pedunculate; prophyll exceeded by terete, rostrate peduncular bract in bud, both caducous at anthesis; flowers borne in 3-7 triads of 2 staminate and a pistillate basally on the rachillae and staminate only distally, these in vertical pairs in 7 series; staminate flowers with 3 imbricate sepals, 3 valvate petals, 6 stamens with filaments inflexed at apex in bud, and columnar pistillode; pistillate flowers larger than staminate, the sepals and petals 3, imbricate, the staminodes 3-6, small, the ovary unilocular, uniovulate; fruit with apical stigmatic residue; mesocarp fleshy; endocarp fragile, operculate at base; seed ovoid, with homogeneous endosperm.

TYPE SPECIES: *Neoveitchia storckii* (H. Wendl.) Becc. (*Veitchia storckii* H. Wendl.).

DISTRIBUTION: A single species endemic to Fiji.

USEFUL TREATMENT OF GENUS: H. E. Moore in Gentes Herb. 8: 537. 1957

1. *Neoveitchia storckii* (H. Wendl.) Becc. Palme Nuova Caledonia, 10. 1920, in Webbia 5: 78. 1921; Burret in Notizbl. Bot. Gart. Berlin 15: 88. 1940; Becc. & Pichi-Serm. in Webbia 11: 109. fig. 31. 1955; A. C. Sm. in J. Arnold Arb. 36: 274. 1955; Moore in Gentes Herb. 8: 538. fig. 156. 1957; J. W. Parham, Pl. Fiji



Isl. 275, fig. 97, 1964, ed. 2, 371, 1972.

FIGURE 84.

Veitchia storckii H. Wendl. in Seem. Fl. Vit. 270, t. 81, 1868; Drake, Ill. Fl. Ins. Mar. Pac. 322, 1892.

Trunk to 12 m. high and 45 cm. in diameter, brown, smooth; leaves to 4.5 m. long, with about 70 pinnae to 75 cm. long and 8 cm. wide on each side; inflorescence 80 cm. long or more, twice-branched, white at anthesis, grayish green in fruit, staminate flowers white, 4.5 mm. high; pistillate flowers 8 mm. high; fruit yellowish or reddish yellow, to 5 cm. long and 2.2 cm. in diameter.

LECTOTYPIFICATION: In the original publication of *Veitchia storckii*, Wendland cited collections of Pickering (i.e. U.S. Exploring Expedition), Storck, and Graeffe, from "Banks of the Rewa River, Viti Levu." Three Provinces, Rewa, Tailevu, and Naitasiri, touch on the Rewa River, but all known localities are in Naitasiri. Of the three original specimens, only *Graeffe* (κ), annotated by Beccari, has been found, and this is herewith designated as the lectotype.

DISTRIBUTION: Endemic to Fiji and thus far known with certainty only from a very limited area in Naitasiri Province, Viti Levu. All known localities fall into an area of no more than 4 × 4 km., west of the Rewa River and near its tributary Waindina River. *Neoveitchia storckii* has been designated an endangered species by the I. U. C. N. (cf. M. L. Gorman & S. Siwatibau in Biol. Conserv. 8: 73, 1975).

LOCAL NAME AND USES: *Vuleito*, the name first noted by Storck, is still in current usage. The fruit is edible when immature, and the trunks have been used as houseposts.

AVAILABLE COLLECTIONS: VITI LEVU: NAITASIRI: Nanduna, near Waindrandra Creek, DA 10133, L.2527; Nanduna Farm, DA 10590; about one mile north of Nanggali Village and bridge over Waindina River, R. & E. F. Melville & Siwatibau 71/948; near Nanggali Village, Moore & Koroiveibau 9360; vicinity of Viria, on Rewa River, Meebold 16780, p. p.

21. *PELAGODOXA* Becc. in Bois in Rev. Hort. II. 15: 302, 1917.

Solitary, erect, pleonanthic, monoecious palms; leaf blades reduplicate-pinnately ribbed, undivided except at bifid apex but often shredded by wind, the margin toothed; inflorescence interfoliar, paniculate, with somewhat fibrous prophyll and terete, rostrate, peduncular bract; flowers borne in triads of 2 staminate and a pistillate in lower 1/4 of rachillae, staminate only distally; staminate flowers yellowish, small, the sepals 3, imbricate, the petals 3, valvate, the stamens 6 with filaments erect in bud, the pistillode conic; pistillate flowers with sepals and petals 3, imbricate, the ovary unilocular, uniovulate; fruit globose, corky-tuberculate; seed globose with hollow, homogeneous endosperm.

TYPE SPECIES: *Pelagodoxa henryana* Becc.

DISTRIBUTION: Marquesas Islands; a monotypic genus.

USEFUL TREATMENTS OF GENUS: Beccari & Pichi-Sermolli in Webbia 11: 179, 1955; H. E. Moore in Principes 1: 173, 1957, in Principes 2: 77, 85, fig. 53, 1958.

1. *Pelagodoxa henryana* Becc. in Bois in Rev. Hort. II. 15: 302, fig. 76-79, 1917; Bois in Bull. Soc. Bot. France 66: 12, 1919, in Rev. Hort. II. 19: 139, fig. 47, 1924; F. Br. in Bishop Mus. Bull. 84: 119, pl. 26, 1931; J. W. Parham in Agr. J. Dept. Agr. Fiji 19: 93, fig. 5, 1948, in op. cit. 29: 33, 1959, Pl. Fiji Isl. 277, 1964, ed. 2, 371, 1972; Gillett in Principes 15: 45, 1971.

Pelagodoxa mesocarpa Burret in Notizbl. Bot. Gart. Berlin 10: 277, 288, fig. 3, 1928.

Stems brown, to 8 m. high, 10–15 cm. in diameter; leaves to 3.5 m. long and 1.2 m. wide, whitish beneath; inflorescence about 70 cm. long; fruits 5.5–10 (–15) cm. in diameter.

TYPIIFICATION AND NOMENCLATURE: The holotype is *M. Henry* (P), collected in 1916 at Taipi Vai, Nuku Hiva, Marquesas Islands. That of *Pelagodoxa mesocarpa* was *Cuming s. n.* (B), now destroyed, illustrated by Burret in 1928 as indicated above. It is apparent that only one species is involved.

DISTRIBUTION: Endemic to the Marquesas Islands and now very rare there; it has been introduced elsewhere and is established on San Cristobal in the Solomon Islands. No herbarium vouchers from Fiji are available; Parham indicates that three specimens were established in the Suva Botanical Gardens, but by 1972 all of them had died.

LOCAL NAME AND USE: *Marquesas palm*; ornamental.

Although Beccari described the fruit of *Pelagodoxa henryana* as 10–15 cm. in diameter, most of those that I have seen are smaller.

22. **DICTYOSPERMA** H. Wendl. & Drude in *Linnaea* 39: 181. 1875; Becc. & Pichi-Serm. in *Webbia* 11: 60. 1955.

Linoma O.F. Cook in J. Wash. Acad. Sci. 7: 123. 1917.

Solitary, erect, pleonanthic, monoecious palms; leaf blade pinnate; sheaths forming a prominent crownshaft; pinnae acute, 1-ribbed, reduplicate at insertion; inflorescence infrafoliar, paniculate, once-branched, the adaxial surface lacking rachillae; prophyll enclosing the peduncular bract and inflorescence in bud, the bracts caducous; flowers borne in triads of 2 staminate and a pistillate nearly throughout the rachillae; staminate flowers with 3 imbricate sepals, 3 valvate petals, 6 stamens with filaments inflexed at apex in bud, and columnar pistillode; pistillate flowers with 3 imbricate sepals and petals, small staminodes, and unilocular, uniovulate ovary; fruit with apical stigmatic residue; endocarp fragile, operculate at base; seed with ruminate endosperm.

TYPE SPECIES: *Dictyosperma album* (Bory) H. Wendl. & Drude ex Scheffer (*Areca alba* Bory). The same species typifies *Linoma* O.F. Cook.

DISTRIBUTION: Mascarene Islands, where formerly widespread, but now nearly extinct in the wild state. As currently delimited, the genus is monotypic.

USEFUL TREATMENT OF GENUS: L. H. Bailey in *Gentes Herb.* 6: 85. 1942.

1. **Dictyosperma album** (Bory) H. Wendl. & Drude ex Scheffer in *Ann. Jard. Bot. Buitenzorg* 1: 157, as *D. alba*. 1876; J. W. Parham in *Agr. J. Dept. Agr. Fiji* 19: 92. 1948.

Areca alba Bory, *Voy. Afr.* 1: 306. 1804.

Dictyosperma album var. *aureum* Balf. f. in Baker, *Fl. Mauritius and Seychelles*, 384. 1877.

Dictyosperma aureum Nicholson, *Ill. Dict. Gard.* 1: 470. 1884.

Dictyosperma furfuraceum Nicholson, *Ill. Dict. Gard.* 1: 470. 1884.

Dictyosperma rubrum Nicholson, *Ill. Dict. Gard.* 1: 470. 1884.

Linoma alba O.F. Cook in J. Wash. Acad. Sci. 7: 123. 1917.

Dictyosperma album var. *rubrum* L. H. Bailey, *Hortus*, 215. 1930.

Trunk to 15 m. high or more, gray or blackish, often furrowed; leaves to 4 m. long; pinnae 50 or more on each side; inflorescence to 60 cm. long; staminate flowers 5–8 mm. long, greenish or reddish; fruit ovoid, to 1.5 cm. long and 1 cm. in diameter.

TYPIIFICATION AND NOMENCLATURE: No type has been located for *Areca alba*. The holotype of *Dictyosperma album* var. *aureum* is *I. B. Balfour s. n.* (K); *D. aureum* is based on this name. The lectotype of *D. rubrum* is designated as *Horne s. n.* (K). No

type material of *D. furfuraceum* has been located, nor is any known for *D. album* var. *rubrum*, which is nomenclaturally distinct from *D. rubrum*. Differences among these various concepts seem minor; the species is variable and its forms intergrade and interbreed freely.

DISTRIBUTION: Mascarene Islands; although the species is now nearly extinct in the wild, it is cultivated in the islands and elsewhere. Parham's record for the species in Fiji was based on a plant growing in the Suva Botanical Gardens which presumably has not persisted, since the species is not mentioned in his later compilations.

23. *CLINOSTIGMA* H. Wendl. in Bonplandia **10**: 196. 1862; Burret in Repert. Sp. Nov. **24**: 292. 1928; Becc. & Pichi-Serm. in Webbia **11**: 113. 1955; H. E. Moore & Fosberg in Gentes Herb. **8**: 458. 1956; H. E. Moore in Principes **13**: 69. 1969.

Kentia sensu Seem. Fl. Vit. 269. 1868; non Adans. nec Bl.

Exorrhiza Becc. in Ann. Jard. Bot. Buitenzorg **2**: 128. 1885; Burret in Repert. Sp. Nov. **24**: 294. 1928, in Notizbl. Bot. Gart. Berlin **12**: 591. 1935; Becc. & Pichi-Serm. in Webbia **11**: 130. 1955; A. C. Sm. in J. Arnold Arb. **36**: 275. 1955.

Bentinckiopsis Becc. Palme Nuova Caledonia, 45, as *Bentnickiopsis*. 1920, in Webbia **5**: 113, as *Bentnickiopsis*. 1921; Becc. & Pichi-Serm. in Webbia **11**: 137. 1955.

Clinostigmopsis Becc. in Martelli in Atti Soc. Tosc. Sci. Nat. Mem. **44**: 161. 1934; Burret in Notizbl. Bot. Gart. Berlin **12**: 591. 1935; Becc. & Pichi-Serm. in Webbia **11**: 118. 1955.

Solitary, erect, pleonanthic, monoecious palms; leaf blades paripinnate; sheaths tubular, forming a prominent crownshaft; pinnae 1-ribbed, acute, reduplicate at insertion; inflorescences infrafoliar, paniculate, short-pedunculate; prophyll completely encircling the peduncle and enclosing the inflorescence and peduncular bract in bud, both bracts caducous at anthesis; flowers borne in triads of 2 staminate and a pistillate nearly throughout the rachillae, staminate only distally; staminate flowers with 3 imbricate sepals, 3 valvate petals, 6 stamens with the filaments inflexed at apex in bud, and an ovoid to conic-ovoid, trifid pistillode; pistillate flowers with 3 imbricate sepals and petals, 3-6 small staminodes, and unilocular, uniovulate ovary; fruit globose to oblong and somewhat compressed with excentrically subapical to lateral stigmatic residue; endocarp thin, operculate; seed with homogeneous endosperm.

TYPE SPECIES: The type species is *Clinostigma samoense* H. Wendl., the only original species. The type species of *Exorrhiza* is *E. wendlandiana* Becc.; the lecto-type species of *Bentinckiopsis* is *B. carolinensis* (Becc.) Becc. (*Cyphokentia carolinensis* Becc.) (vide Pichi-Sermolli in Webbia **11**: 138. 1955); and that of *Clinostigmopsis* is *C. thurstonii* (Becc.) Becc. (*Clinostigma thurstonii* Becc.) (vide Pichi-Sermolli in Webbia **11**: 118. 1955).

DISTRIBUTION: Bonin Islands, Caroline Islands, Solomon Islands, New Hebrides, Fiji, and Samoa. The genus, as now understood, probably contains 8-10 species, of which one is indigenous in Fiji. In reporting *Exorrhiza* to terminate its range in Fiji, Smith in 1955 was taking that genus as distinct from *Clinostigma*.

1. *Clinostigma exorrhizum* (H. Wendl.) Becc. in Martelli in Nuovo Giorn. Bot. Ital. II. **41**: 22, 53, as *C. exorrhiza*. 1935; Burret in Notizbl. Bot. Gart. Berlin **12**: 592. 1935; H. E. Moore & Fosberg in Gentes Herb. **8**: 460. fig. 136, *E*, as *C. exorrhiza*. 1956; J. W. Parham, Pl. Fiji Isl. ed. 2. 369, as *C. exorrhiza*. 1972. FIGURE 85.

Areca? exorrhiza H. Wendl. ex Seem. in Bonplandia **9**: 260, as *A. exorrhiza*, nom. nud. 1861; H. Wendl. in Bonplandia **10**: 191, pro syn. 1862; Seem. Fl. Vit. 270, pro syn. 1868.

Kentia exorrhiza H. Wendl. in Bonplandia **10**: 191, excl. fr. 1862; Seem. Vit. 29, 367, 370, 444. 1862, Fl. Vit. 269. t. 78. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 322, 410. 1892.



FIGURE 85. *Clinostigma exorrhizum*, from Smith 1879; habit.

- Exorrhiza wendlandiana* Becc. in Ann. Jard. Bot. Buitenzorg 2: 128. 1885; Burret in Repert. Sp. Nov. 24: 295. 1928, in Notizbl. Bot. Gart. Berlin 12: 592. 1935; J. W. Parham, Pl. Fiji Isl. 275, fig. 95. 1964.
- Clinostigma thurstonii* Becc. in Webbia 3: 145, fig. 3. 1910.
- Clinostigmopsis thurstonii* Becc. in Martelli in Atti Soc. Tosc. Sci. Nat. Mem. 44: 162. 1934.
- Clinostigma seemannii* Becc. in Martelli in Nuovo Giorn. Bot. Ital. II. 41: 39, 53. 1935; Becc. & Pichi-Serm. in Webbia 11: 133, pro syn. 1955.
- Exorrhiza thurstonii* Burret in Notizbl. Bot. Gart. Berlin 12: 593. 1935.
- Exorrhiza smithii* Burret in Occas. Pap. Bishop Mus. 11 (4): 3. 1935, in Notizbl. Bot. Gart. Berlin 12: 593. 1935; J. W. Parham, Pl. Fiji Isl. 274. 1964.
- Clinostigma smithii* H. E. Moore & Fosberg in Gentes Herb. 8: 462. 1956; J. W. Parham, Pl. Fiji Isl. ed. 2. 369. 1972.

Trunk to about 20 m. high, 25–35 cm. in diameter, whitish when young, brown in age; stilt roots brown, spiny, to nearly 3 m. high; leaves to 5.5 m. long; sheath light green with glaucous cast, to 1.2 m. long; petiole 30–60 cm. long; pinnae 60–100 on each side, more or less pendulous; inflorescence 50–65 cm. long, 3-times branched, the axes yellowish or whitish at anthesis, green in fruit; staminate flowers cream-colored to brown-orange with white filaments and orange pistillode, scented; fruit translucent red, with apically excentric stigmatic residue, about 6 mm. high and 4 mm. in diameter, drying pebbled.

TYPIFICATION AND NOMENCLATURE: The holotype of *Kentia exorrhiza*, as also that of *Exorrhiza wendlandiana* and *Clinostigma seemannii*, is *Seemann 660* (K), excluding the fruit originally described by Wendland but later (in Seem. Fl. Vit. 271. 1868) ascribed by him to *Veitchia joannis*. *Seemann 660* (cf. Viti, 29. 1862) was collected May 30, 1860, on the edge of the crater lake east of Somosomo, Taveuni. The holotype of *Clinostigma thurstonii* is *Thurston s. n.* (K), collected Sept. 18, 1889, near the northeastern extremity of Vanua Levu, and that of *Exorrhiza smithii* is *Smith 1879* (BISH), collected June 5, 1934, on the eastern buttress of Mt. Ndikeya, Thakaundrove Province, Vanua Levu. With ample material now at hand, the differences among these taxa are seen to be inconsequential.

DISTRIBUTION: Endemic to Fiji and thus far known from Viti Levu, Ngau, Vanua Levu, and Taveuni. It occurs at elevations of 230–900 m., more commonly at the upper levels, in dense forest and crest thickets.

LOCAL NAMES: *Niumiu*; *nusawa* (recorded by Seemann but more likely referable to *Veitchia joannis*); *nusao* (recorded by Parham in 1964, but probably an error in transcription for *nusau*).

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Tavuki ni mandrai, Mt. Koromba, DA 14749, NAITASIRI: Matawailevu, track to Vunindakua, Wainimala River, DA 18157; ridge crests and sides, Wainindambeuta, on trail from Nasauvere to Taunaisali, Wainimala River, Moore, *Vodonaivalu, Koroi, & Sunder-san 10007*. NGAU: Slopes of Mt. Ndelaitho, on northern spur, toward Navukailangi, *Smith 7891*. VANUA LEVU: THAKAUNDOVE: Track to Mt. Soro Levu, DA 17133; uppermost slopes and ridges of Mt. Mariko on trail from Mbuthalevu to summit, Moore & *Koroiveibau 9346*. TAVEUNI: Hills east of Somosomo, west of old crater lake, *Smith 8364*, Moore & *Koroiveibau 9355*; above Nggathavulo Estate, DA 16933. FIJI without further locality, *Horne 838*.

24. CYPHOSPERMA H. Wendl. ex Hook. f. in Benth. & Hook. f. Gen. Pl. 3: 895. 1883; H. E. Moore in Principles 21: 88. 1977.

Taveunia Burret in Occas. Pap. Bishop Mus. 11 (4): 12. 1935; A. C. Sm. in J. Arnold Arb. 36: 275. 1955; H. E. Moore in Candollea 20: 91. 1965.

Solitary, erect, pleonanthic, monoecious palms; leaf blades paripinnate; sheaths split abaxially, not forming a prominent crownshaft; pinnae 1-ribbed, acute, reduplicate at insertion; inflorescence interfoliar, paniculate, long-pedunculate; prophyll open abaxially and not completely encircling peduncle in bud, the peduncular bract terete, enclosing inflorescence in bud, both bracts marcescent on peduncle; branches and rachillae with a prominent pulvinus at base; flowers borne in triads of 2



staminate and a pistillate nearly throughout the rachillae, staminate only distally; staminate flowers with 3 imbricate sepals, 3 valvate petals, 6 stamens with filaments inflexed at apex in bud, and prominent pistillode; pistillate flowers with 3 imbricate sepals and petals, 3 small staminodes, and unilocular, uniovulate ovary; fruit with stigmatic residue excentrically apical to lateral in upper 1/4–1/3, drying pebbled; mesocarp with short fibers nearly perpendicular to epicarp and external to flat fibers and tannin cells in parenchyma; endocarp fragile, irregularly sculptured and angled with adaxial groove or ridge, operculate at base; seed sculptured like endocarp, with homogeneous endosperm.

LECTOTYPE SPECIES: *Cyphosperma balansae* (Brongn.) H. Wendl. ex Salomon (*Cyphokentia balansae* Brongn.) (vide Becc. *Palme Nuova Caledonia*, 33. 1920, in *Webbia* 5: 101. 1921). The type species of *Taveunia* is *T. trichospadix* Burret.

DISTRIBUTION: New Caledonia and Fiji; three species, of which two are endemic to Fiji.

USEFUL TREATMENT OF GENUS: Beccari & Pichi-Sermolli in *Webbia* 11: 120. 1955.

KEY TO SPECIES

Leaf uniformly divided into 20–28 acute to acuminate 1-ribbed pinnae, the midrib and 2 prominent veins lacking linear scales on the upper surface; fruit about 2 cm. long when fresh, drying 1.6–1.8 cm. long.

1. *C. trichospadix*

Leaf elongate-cuneate in outline and undivided except at the bifid apex, or irregularly divided toward apex and then with few unequal and scarcely disjunct pinnae, or rarely regularly pinnate, the midrib and principal veins with linear scales on upper surface; fruit about 1.3 cm. long. 2. *C. tanga*

1. *Cyphosperma trichospadix* (Burret) H. E. Moore in *Principes* 21: 88. 1977.

Taveunia trichospadix Burret in *Occas. Pap. Bishop Mus.* 11 (4): 13. 1935; A. C. Sm. in *J. Arnold Arb.* 36: 275. 1955; J. W. Parham, *Pl. Fiji Isl.* 278. 1964, ed. 2. 374. 1972; H. E. Moore in *Candollea* 20: 93. fig. 1–4. 1965.

Trunk to 7 m. high and 8.5 cm. in diameter, bright green, becoming brown in age; leaves 1.5–1.8 m. long; inflorescence 0.9–1.5 m. long; peduncle 50–65 cm. long; rachis nearly as long as peduncle, bearing about 13 branches to 60 cm. long; flowers greenish, about 3 mm. high; fruit oblong-ellipsoid, drying pebbled.

TIPIFICATION: The holotype was *Weber 112* (B), collected Oct. 2, 1881, on Taveuni without detailed locality. Since this has presumably been destroyed, *Moore & Koroiveibau 9354* (BH), collected Apr. 23, 1964, on steep slopes below crest of mountain on trail from Somosomo to crater lake, Taveuni, is designated as the neotype.

DISTRIBUTION: Endemic to Fiji and thus far known only from Vanua Levu and Taveuni, where it occurs in dense forest between 600 and 760 m. altitude. Burret mentioned the species as "widely distributed in the hills of Taveuni, generally below 300 m."; this information was presumably taken from the holotype, but I am inclined to doubt its accuracy.

AVAILABLE COLLECTIONS: VANUA LEVU: THAKAUNDROVE: Slopes of Mt. Mariko on trail from Mbiungunu to Korosi, *Bierhorst F130*; upper slopes and ridges of Mt. Mariko on trail from Mbuthalevu to summit, *Moore & Koroiveibau 9345*. TAVEUNI: Track from Somosomo to crater lake, *DA 17118*, 17119.

2. *Cyphosperma tanga* (H. E. Moore) H. E. Moore in *Principes* 21: 88. 1977.

FIGURE 86.

Taveunia tanga H. E. Moore in *Candollea* 20: 98. fig. 5–7. 1965; J. W. Parham, *Pl. Fiji Isl.* ed. 2. 373. 1972.

Trunk to about 5 m. high, 10–20 cm. in diameter, green-brown; leaves 1.7–1.9 m. long, undivided except at apex or irregularly divided into few broad, scarcely disjunct pinnae, or rarely regularly pinnate; inflorescence about 2 m. long or more; peduncle about 1.2 m. long; rachis about 83 cm. long, bearing 8 branches to 80 cm. long or more; flowers greenish, about 2.2 mm. high; fruit greenish yellow, drying pebbled.

TYPEFICTION: The holotype is *Moore & Koroiveibau 9364* (BH), collected May 4, 1964, among rocks in forest along Vuninatambua Creek, between Ndromondromo and Vuninatambua ridge, Mba Province, Viti Levu.

DISTRIBUTION: Endemic to Fiji and thus far known only from Viti Levu, where in my observation it occurs in dense forest at elevations of 750–900 m. However, the collection from Serua Province listed below must have been obtained at an elevation of less than 600 m.

LOCAL NAME AND USE: Although I originally noted the local name as *tanga*, I believe that *tangga* is more correct. The seed and heart bud are reported by Degener to be edible.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Vuninatambua, Navai, *Degener 14793*. SERUA: Inland from Namboutini, *DA 13992*.

25. *PHYSOKENTIA* Becc. *Palme Nuova Caledonia*, 37, nom. nud. 1920, in *Webbia* 5: 105, nom. nud. 1921, in Martelli in *Atti Soc. Tosc. Sci. Nat. Mem.* 44: 152. 1934; Becc. & Pichi-Serm. in *Webbia* 11: 128. 1955.

Goniosperma Burret in *Occas. Pap. Bishop Mus.* 11 (4): 10. 1935, in *Notizbl. Bot. Gart. Berlin* 12: 594. 1935; A.C. Sm. in *J. Arnold Arb.* 36: 275. 1955; Becc. & Pichi-Serm. in *Webbia* 11: 126. 1955.

Solitary, erect, pleonanthic, monoecious palms, with prominent stilt roots; trunks prominently ringed; leaf blades paripinnate; sheaths tubular, forming a prominent crownshaft; petiole short; pinnae acute, 1-ribbed or several-ribbed, reduplicate at insertion; inflorescences infrafoliar, paniculate; prophyll incomplete abaxially in bud, not completely encircling peduncle at insertion, the peduncular bract terete and enclosing inflorescence in bud, both caducous at anthesis; flowers borne in triads of 2 staminate and a pistillate in lower 1/3 or more of rachillae, staminate only distally, or rarely inflorescence entirely staminate; staminate flowers asymmetrical, with 3 imbricate sepals, 3 valvate petals, 6 stamens with filaments inflexed at apex in bud, and prominent pistillode; pistillate flowers with 3 imbricate sepals and petals, 3 small staminodes, and unilocular, uniovulate ovary; fruit with excentrically apical stigmatic residue; mesocarp fleshy; endocarp variously angled or ridged, operculate; seed angled or ridged like endocarp; endosperm homogeneous or ruminate.

LECTOTYPE SPECIES: *Physokentia tete* (Becc.) Becc. (*Cyphosperma tete* Becc.) (vide Burret in *Occas. Pap. Bishop Mus.* 11 (4): 11. 1935). The type species of *Goniosperma* is *G. vitiense* Burret.

DISTRIBUTION: New Britain, Solomon Islands, New Hebrides, and Fiji; seven species are now known, two of which are indigenous in Fiji.

USEFUL TREATMENT OF GENUS: H. E. Moore in *Principes* 13: 120. 1969.

KEY TO SPECIES

Staminate and pistillate flowers white or at most pink-flushed on white or ivory-colored rachillae; bracteoles and margins of staminate pedicels white-barbate; fruit about 2–2.1 cm. in diameter when dry.

1. *P. thurstonii*

Staminate flowers with rose-red petals and red-black sepals; bracteoles and pedicels of staminate flowers glabrous or with a few brownish hairs; pistillate buds with red-black sepals and wine-red petals; inflorescence axes deep rose; fruit 1.4–1.9 cm. in diameter when dry. 2. *P. rosea*

1. *Physokentia thurstonii* (Becc.) Becc. in Martelli in Atti Soc. Tosc. Sci. Nat. Mem. **44**: 154. 1934; H. E. Moore in Principes **10**: 92. fig. 3, *b-h*, *p-v*. 1966, in op. cit. **13**: 128. fig. 1, *b-h*, *p-v*; fig. 2, *B*. 1969; J. W. Parham, Pl. Fiji Isl. ed. 2. 373. 1972.

Cyphosperma thurstonii Becc. in Webbia **4**: 272. fig. 25. 1914.

Goniosperma vitiense Burret in Occas. Pap. Bishop Mus. **11** (4): 11. 1935, in Notizbl. Bot. Gart. Berlin **12**: 594. 1935; A. C. Sm. in J. Arnold Arb. **36**: 275. 1955; J. W. Parham, Pl. Fiji Isl. 275. 1964, ed. 2. 371. 1972.

Goniosperma thurstonii Burret in Occas. Pap. Bishop Mus. **11** (4): 12. 1935, in Notizbl. Bot. Gart. Berlin **12**: 594. 1935; A. C. Sm. in J. Arnold Arb. **36**: 275. 1955; J. W. Parham, Pl. Fiji Isl. 275. 1964.

Trunk to 7 m. high and 10 cm. in diameter, bright to dark green; stilt roots to 2 m. high; leaves to 3 m. long; pinnae 23–40 on each side, 1-ribbed; inflorescence 30–50 cm. long; staminate flowers 5–6 mm. long; fruit subglobose, purplish black.

TIPIFICATION AND NOMENCLATURE: The holotype of *Cyphosperma thurstonii* is *Thurston s. n.* (K), consisting of fruits only, collected April 17, 1882, on Taveuni without further locality; that of *Goniosperma vitiense* is *Smith 417* (BISH), collected Nov. 14, 1933, on Mt. Mariko, Thakaundero Province, Vanua Levu. In describing the latter, Burret indicated that it might prove identical to the former, known only from fruits; the adequate material now available bears out this suggestion.

DISTRIBUTION: Endemic to Fiji and thus far known only from Vanua Levu and Taveuni, where it is found in dense forest between 600 and 900 m.

LOCAL NAME: *Niuniu*.

AVAILABLE COLLECTIONS: VANUA LEVU: MBUA: Mt. Seatura, *DA 15165*. THAKAUNDERO: Track to Mt. Soro Levu, *DA 17132*; slopes of Mt. Mariko, on trail from Mbiungunu to Korosi, *Bierhorst F134*; upper slopes of Mt. Mariko on trail from Mbuthalevu Village to summit, *Moore & Koroiveibau 9347*. TAVEUNI: Near Rairai Ndreketi, track from Somosomo to crater lake, *DA L.26191*; steep slopes below crest of mountain on trail from Somosomo to crater lake, *Moore & Koroiveibau 9353*.

2. *Physokentia rosea* H. E. Moore in Principes **10**: 90. fig. 3, *a*, *i-o*. 1966, in op. cit. **13**: 127. fig. 1, *a*, *i-o*; fig. 2, *D*. 1969; J. W. Parham, Pl. Fiji Isl. ed. 2. 372. 1972.

Goniocladus petiolatus sensu A. C. Sm. in J. Arnold Arb. **31**: 147. 1950; non Burret.

Trunk to 8 m. high and 10 cm. in diameter, green; stilt roots about 1 m. long; leaves to 2 m. long; pinnae about 23–35 on each side, 1-ribbed; inflorescence 50 cm. long or more; staminate flowers 4–5 mm. long; fruit globose, blackish.

TIPIFICATION: The holotype is *Moore & Koroiveibau 9363* (BH), collected May 2, 1964, on upper slopes and ridges from Mt. Nanggaranambuluta beyond second peak in easterly direction, Ra Province, Viti Levu.

DISTRIBUTION: Endemic to Fiji and thus far known only from Viti Levu, where it occurs in dense forest and ridge forest at elevations of 750–1,120 m.

LOCAL NAME: *Tangandanu* (recorded by Degener).

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Vuninatambua, Nava'i, *Degener 14792*. NANDRONGA & NAVOSA: Vicinity of Nandrau, *Degener 14893*. RA: Ridge from Mt. Namama (east of Nandarivatu) toward Mt. Tomanivi, *Smith 5700*. NAITASIRE: Taunaisali, on Rairaimatuku Plateau between headwaters of Wainimala and Singatoka Rivers, *Moore, Vodonaivalu, Koro'i, & Sundersan 10008*; track from Matawailevu to Vunindakua, Wainimala River, *DA 18158*.

26. *GONIOCLADUS* Burret in Notizbl. Bot. Gart. Berlin **15**: 86. 1940; A. C. Sm. in J. Arnold Arb. **36**: 275. 1955; Becc. & Pichi-Serm. in Webbia **11**: 124. 1955.

Solitary, erect, pleioanthic, monoecious palms; leaf blades paripinnate; sheaths tubular, forming a prominent crownshaft; petiole short; pinnae acute to acuminate, 1-ribbed, reduplicate at insertion; inflorescences infrapetiole, paniculate; prophyll attachment not known, the peduncular bract slightly longer than prophyll, both

caducous at anthesis; flowers borne in spirally arranged triads of 2 staminate and a pistillate nearly to apex of rachillae; immature staminate flowers symmetrical in bud, rounded, with 3 imbricate (?) sepals, 3 valvate (?) petals, 6 stamens, very short filaments erect (?) in bud, and columnar, scutate-capitate pistillode; pistillate flowers with 3 imbricate (?) sepals and petals, few small staminodes, and unilocular, uniovulate ovary; young fruit with excentric stigmatic residue, densely granulose when dry, with dense transverse sclerosomes; seed not known.

TYPE SPECIES: *Goniocladus petiolatus* Burret, the only original species.

DISTRIBUTION: Endemic to Fiji and monotypic.

1. *Goniocladus petiolatus* Burret in Notizbl. Bot. Gart. Berlin **15**: 87. 1940; A. C. Sm. in J. Arnold Arb. **36**: 275. 1955; J. W. Parham, Pl. Fiji Isl. 275. 1964, ed. 2. 370. 1972.

Trunk 7 m. high and 20 cm. in diameter; petiole about 15 cm. long, deeply channeled above; rachis slightly more than 1 m. long, densely but deciduously furfuraeous on both surfaces; pinnae 23 or 24 on each side, paler beneath than above, with medifixed linear ramenta on midribs beneath, minutely fuscous-punctulate on midrib, on 1 prominent vein on each side, and on surface beneath; inflorescence 3-times branched, to 30 cm. long; peduncle 3 cm. long, flattened, 7 mm. wide at apex, the scars of bracts close together; prophyll thin, papery, glabrous, oblanceolate, 14 cm. long with a rostrum 7 cm. long, 4 cm. in diameter above, the peduncular bract lanceolate, briefly acuminate, 16 cm. long, 4 cm. in diameter; axes glabrous, more or less flattened and longitudinally angled; rachillae 12.5–20 cm. long, attenuate to an almost spinose apex; staminate buds elliptic-oblong in outline; sepals navicular, dorsally keeled, rather large, acute below, strongly cucullate above; petals elliptic-oblong; pistillode scarcely exceeding stamens; immature fruit obliquely ovate.

TIPIFICATION: The holotype was *St. John* 18338, collected Aug. 18, 1937, on the Rairaimatuku Plateau between Numbulolo Creek (Singatoka River drainage) and Wainisavulevu Creek (Wainimala River drainage), near the Nandronga & Navosa-Naitasiri boundary, Viti Levu. Unfortunately all the material of this collection, including duplicates, was sent to Burret on loan in the late 1930's and was presumably destroyed. Burret implied that he intended to return the holotype and other duplicates to BISH, retaining an isotype for B.

DISTRIBUTION: Endemic to Fiji and now known only from the original description, from which the above is taken. The specimens were obtained in rain forest at an elevation of 1,158 m.

LOCAL NAME: *Na tana*.

In an attempt to obtain new material of this species and genus I reached essentially the type locality (see citation under *Physokentia rosea*). However, *P. rosea* differs from *Goniocladus petiolatus* in having the inflorescence branched only two times and rachillae with triads in the lower 1/4–1/2, in its trifid rather than scutate-capitate pistillode, and in its fruit lacking transverse sclerosomes. According to Burret's description, *Goniocladus* cannot be synonymized with *Physokentia*, and one must hope for further collections to place it properly.

27. Cocos L. Sp. Pl. 1188. 1753; Seem. Fl. Vit. 275. 1868.

Solitary, erect, pleonanthic, monoecious palms; leaf blades paripinnate; sheaths fibrous, not forming a crownshaft; petiole elongate; pinnae acute, 1-ribbed, reduplicate at insertion; inflorescence interfoliar, paniculate or very rarely spicate, with short prophyll and terete, woody, peduncular bract enclosing the inflorescence in bud and persisting on the peduncle after anthesis; flowers borne in triads of 2 stam-

inate and a pistillate at base of rachilla, staminate only distally; staminate flowers with 3 small imbricate sepals, 3 valvate petals, 6 stamens, and short pistillode; pistillate flowers large, globose, with 3 imbricate sepals and petals, staminodes connate in a ring, and trilocular, triovulate ovary; fruit large, 1-seeded; mesocarp fibrous; endocarp bony, with 3 basal pores; seed large, hollow; endosperm homogeneous.

TYPE SPECIES: *Cocos nucifera* L.

DISTRIBUTION: Old World tropics; a monotypic cultigen, perhaps Melanesian but origin not certain.

USEFUL TREATMENTS OF GENUS: K. P. V. Menon & K. M. Pandalai. The Coconut Palm: a Monograph. Ernakulam, India. 1-384. 1958. I. H. Burkill, Dict. Econ. Prod. Malay Penins. ed. 2. 603-624. 1966.

1. *Cocos nucifera* L. Sp. Pl. 1188. 1753; Seem. Viti, 285, 367, 444. 1862, Fl. Vit. 275. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 323. 1892; Christophersen in Bishop Mus. Bull. 128: 37. 1935; Yuncker in op. cit. 178: 27. 1943, in op. cit. 184: 27. 1945; J. W. Parham in Agr. J. Dept. Agr. Fiji 19: 92. 1948; H. E. Moore & Fosberg in Gentes Herb. 8: 471. fig. 138. 1956; Yuncker in Bishop Mus. Bull. 220: 74. 1959; J. W. Parham in Agr. J. Dept. Agr. Fiji 29: 32. 1959, Pl. Fiji Isl. 272. fig. 94. 1964, ed. 2. 369. fig. 101. 1972; Sykes in New Zealand Dept. Sci. Indust. Res. Bull. 200: 266. 1970.

Trunk often curved and thickened at base, to 30 m. high; leaves to 6 m. long or more; inflorescence to 1.8 m. long; staminate flowers yellow, fragrant, 1.2-1.5 cm. long; pistillate flowers about 2.5 cm. in diameter; fruit 20-30 cm. long or more, green, brown, or orange at maturity.

TYPEIFICATION: Linnaeus gives several prior references and a brief description, but I am not aware of an adequate lectotypification of this common species.

DISTRIBUTION: Widely cultivated in the tropics of the New and Old Worlds as an economic plant. It is not surprising that only one Fijian herbarium voucher is available, as collectors are prone to neglect preparing specimens of abundant, well-known, and unwieldy plants.

LOCAL NAMES AND USES: *Coconut*; *niu*; *niu ndina*; many cultivars have local names that are listed by Parham (1964, 1972, cited above). Without doubt the coconut was the most important plant in the everyday life of Fijians, its uses being too numerous to discuss here. In modern times it is perhaps exceeded only by sugarcane in its importance to the economy of Fiji; Parham estimates that coconut trees for copra production in Fiji occupy 170,000 acres. For extended discussions of the uses of the coconut the reader is referred to the treatments of Menon and Pandalai and of Burkill, listed above, and also to the interesting discussion of J. W. Purseglove (*Tropical Crops: Monocotyledons*, 440-479. 1972), who cites an extensive literature.

AVAILABLE COLLECTION: LAKEMBA: Levuka Village, Leslie & Delai, June 27, 1977.

The origin and distribution of the coconut remain topics of controversy to the present day, and theories are too complex to be mentioned here. Purseglove (pp. 444-450) gives a good summary, and Seemann (*Flora Vitiensis*, pp. 275-278) presented a fascinating account for its period.

28. ELAEIS Jacq. Select. Stirp. Amer. 280. 1763.

Solitary, erect or prostrate, pleonanthic, monoecious palms; leaf blades paripinnate; sheaths fibrous; petiole with marginal teeth basally; pinnae 1-ribbed, acute, reduplicate at insertion; inflorescence interfoliar, usually unisexual; prophyll and peduncular bract fibrous, marcescent; staminate flowers numerous, crowded, paired or solitary in the axils of connate bracteoles that resemble a honeycomb, the sepals

and petals 3, distinct, the stamens 6; pistillate flowers more or less sunken in the rachilla, subtended by acute to acuminate bracteoles, the sepals and petals 3, imbricate, the ovary trilocular, triovulate; fruit 1-seeded; mesocarp oily; endocarp bony, with 3 pores above the middle; seed with homogeneous endosperm.

TYPE SPECIES: *Elaeis guineensis* Jacq., the only original species.

DISTRIBUTION: Tropical Africa, Madagascar, and tropical America; two species, one of which is cultivated in Fiji.

USEFUL TREATMENT OF GENUS: C. W. S. Hartley. The Oil Palm (*Elaeis guineensis* Jacq.). Longmans, Green & Co., London. 1-706. 1967.

1. *Elaeis guineensis* Jacq. Select. Stirp. Amer. 280. *t.* 172. 1763; J. W. Parham in Agr. J. Dept. Agr. Fiji 19: 92. 1948, in op. cit. 29: 32. 1959, Pl. Fiji Isl. 274, as *Elaeius* g. 1964, ed. 2. 370. 1972; Sykes in New Zealand Dept. Sci. Indust. Res. Bull. 200: 266. 1970.

Trunk erect, to 20 m. high, often roughened by petiole bases; leaves to 5 m. long, the pinnae mostly paired or grouped and borne in several planes; inflorescence short-pedunculate; staminate flowers yellow, fragrant; fruit ovoid or conic-ovoid, red at maturity, about 2.5 cm. in diameter.

TYPIFICATION: The type, lacking any known specimen, may be taken as Select. Stirp. Amer. *t.* 172, probably based on a plant from Martinique.

DISTRIBUTION: Tropical west and central Africa, probably introduced into east Africa and Madagascar, now cultivated throughout the tropics as an ornamental or in plantations for its fruit. Although no herbarium vouchers from Fiji are available, the species was introduced there in the 1880's, but it has not been grown on a commercial scale. In recent years trial blocks have shown promise and experimental work is continuing with a view to growing this palm commercially (Parham, 1964, 1972, cited above).

LOCAL NAME AND USES: *Oil palm*, the name in universal use. Both pericarp and endosperm yield important commercial oils. Many other uses and details of interest are provided by Burkill (Dict. Econ. Prod. Malay Penins. ed. 2. 908-914. 1966) and Pursglove (*Tropical Crops: Monocotyledons*, 479-510. 1972).

ORDER ARALES

KEY TO FAMILIES

- Plants with roots, stems, and leaves, terrestrial or sometimes aquatic, rarely free-floating (not in our genera); inflorescence a spike (spadix) subtended by a large bract (spathe); stamens usually 4-6; ovary with 1-many locules and 1-many ovules variously attached. 40. ARACEAE
- Plants aquatic, small to minute, floating or submerged, with or without short, slender roots, and with small, discoid, leafless, thalloid fronds; inflorescence emerging from a fissure (budding pouch) in the frond, composed of 1 or 2 ♂ and 1 ♀ flowers, the spathe lacking or membranous and reduced; stamen 1, the anther 1- or 2-locular; ovary 1-locular, with 1-4 basal, erect ovules. 41. LEMNACEAE

FAMILY 40. ARACEAE

BY DAN H. NICOLSON

(U.S. National Museum of Natural History, Smithsonian Institution)

ARACEAE Juss. Gen. Pl. 23, as *Aroideae*. 1789.

Erect herbs or somewhat woody climbers, unarmed or sometimes aculeate, with aerial stems or subterranean, often starchy, rhizomes; leaves alternate, rarely soli-

tary, ranging from simple to variously decompound; inflorescence a spike (spadix) of sessile, bractless flowers subtended by a large bract (spathe); perianth none or 4–6 free or united tepals; flowers bisexual or unisexual, when unisexual the lower flowers pistillate and the upper flowers staminate, sometimes various portions of the spadix naked or covered with sterile flowers; stamens usually 4–6 per flower, free or united in syndrindria; pistils usually free, with 1-many locules, with 1-many ovules variously attached; fruit a berry, 1-many-seeded.

DISTRIBUTION: Worldwide, except for Antarctica and southern South America, with about 120 genera and 2,000 species. In Fiji *Epipremnum* and *Rhaphidophora* are presumably indigenous; *Alocasia*, *Amorphophallus*, *Colocasia*, and *Cyrtosperma* are probably of aboriginal introduction, and the remaining genera are doubtless relatively recent introductions. Several genera are cultivated as starch sources, particularly *Alocasia*, *Amorphophallus*, *Colocasia*, *Cyrtosperma*, and *Xanthosoma*; most of the other introductions are of ornamental value. Twelve genera are known definitely to occur in Fiji, represented by 14 species. Of these, two species are probably indigenous, one of them being considered endemic; five species are known only in cultivation; and seven species were presumably introductions as food plants, now occurring in cultivation but also occasionally naturalized. One of the indigenous species is also represented by a variegated cultivar, but probably this is a recent introduction rather than a local development. It is quite possible that other genera may be cultivated in Fiji, such as *Philodendron* and *Syngonium*, commonly cultivated climbers, *Spathiphyllum*, with showy spathes, and *Aglaonema*, often cultivated as a foliage plant. However, none of these four genera has actually been collected in Fiji or recorded in the pertinent literature, and consequently they are omitted from the present treatment.

USEFUL TREATMENTS OF FAMILY: The most recent monograph of the family is that of A. Engler (in part with K. Krause), the Araceae (family IV.23) having been revised in nine volumes (1905–1920, with different Heft numbers) of *Das Pflanzenreich*. Information on aroids cultivated as starch sources has been presented by J. Barrau (in J. Agr. Trop. Bot. Appl. 4: 34–52, 1957) and also by J. W. Purseglove (*Tropical Crops, Monocotyledons*, 58–74, 1972). Good descriptive notes on many species that also occur in Fiji are found in C. A. Backer & R. C. Bakhuizen van den Brink, Jr. (Fl. Java 3: 100–126, 1968).

KEY TO GENERA

Plants caulescent and climbing; flowers bisexual and naked.

Ovary bilocular with 2 basal ovules in each locule; leaves often with large holes (at least in Fiji).

1. *Monstera*

Ovary unilocular with 2-many parietal or subparietal ovules; leaves without large holes.

Ovules 2–4, subbasal on a single intrusive parietal placenta; leaves pinnatifid in adult aspect.

2. *Epipremnum*

Ovules many, on two intrusive parietal placentae; leaves always entire. 3. *Rhaphidophora*

Plants erect, acaulescent or if caulescent then not climbing; flowers unisexual and naked or bisexual with perianth.

Cultivated for bright and showy spathes.

Spathe scarlet; venation reticulate; flowers bisexual, each with 4 fleshy, scalelike tepals.

4. *Anthurium*

Spathe white; venation striate; flowers unisexual. 5. *Zantedeschia*

Cultivated for food or ornamental leaves.

Leaf solitary, dichotomously decompound; inflorescence arising before leaf. . . . 6. *Amorphophallus*

Leaves several, entire; inflorescence borne among leaves.

Flowers bisexual; plants often with aculeate petioles; venation irregularly reticulate.

7. *Cyrtosperma*

Flowers unisexual; plants unarmed; major venation striate.

Pistillate portion of spadix attached to spathe; spathe entirely persistent; secondary venation striate. 8. *Dieffenbachia*

Pistillate portion of spadix free from spathe; blade of spathe quickly withering; secondary veins meeting between primary veins to form a vein paralleling the primary veins.

Spadix with sterile terminal portion.

Ovules 3-5, the seeds large; leaves not or only slightly peltate (for 1 cm. or less).

9. *Alocasia*

Ovules many, the seeds small; leaves peltate for several centimeters. 10. *Colocasia*

Spadix covered with flowers to end.

Leaves peltate, variegated (at least in Fiji). 11. *Caladium*

Leaves sagittate, not peltate, not variegated. 12. *Xanthosoma*

1. *MONSTERA* Adanson, Fam. Pl. 2: 470. 1763; Engl. & Krause in Pflanzenr. 37 (IV. 23B): 97. 1908. Nom. cons.

Climber; spathe oblong-ovate, soon deciduous, full of trichosclereids; spadix covered with fertile flowers, sometimes sterile at extreme ends; flowers bisexual, naked, with 4 stamens; pistil bilocular, each locule with 2 basal ovules; seeds large, smooth, few, ovoid.

TYPE SPECIES: *Monstera adansonii* Schott (*Dracontium pertusum* L., incl. *M. pertusa* (L.) De Vriese, 1839, non (Roxb.) Schott, 1830). Typ. cons.

DISTRIBUTION: About 22 species in the neotropics, some in cultivation as ornamental vines.

Bakhuizen van den Brink (in Blumea Suppl. 4: 91-92. 1958) has suggested that *Rhaphidophora* and *Epipremnum*, of the paleotropics, may be congeneric with *Monstera*, an idea rejected by Madison (in Contr. Gray Herb. 207: 3-100. 1977).

1. *Monstera deliciosa* Liebm. in Vidensk. Meddel. Dansk Naturhist. Foren. Kjøbenhavn 1849-50: 19. 1849; Engl. & Krause in Pflanzenr. 37 (IV. 23B): 111. 1908; J. W. Parham, Pl. Fiji Isl. 267. 1964, ed. 2. 363. 1972.

Philodendron pertusum Kunth & Bouché in Kunth, Sp. Nov. Ind. Sem. Hort. Berol. 1848: 11. 1849.

Heavy epiphytic liana; geniculum flattened and with wrinkled wings; blade to 1.2 m. long and broad, cordate, pinnatifid and foraminat; spathe whitish, quickly withering; spadix 20-30 × 4-5 cm.

TYPIFICATION AND NOMENCLATURE: *Liebmann s. n.* (C), from Oaxaca, Mexico, is the holotype of *Monstera deliciosa*. *Philodendron pertusum* was described from material cultivated in Berlin from a collection made in Guatemala by Warszewicz.

DISTRIBUTION: Native to Central America at elevations of about 1,000 m., but now widespread in cultivation. No Fijian herbarium specimens are available, but Parham has indicated that the species was introduced into Fiji in the 1880's; it doubtless exists there only in cultivation.

LOCAL NAME AND USES: According to Parham the species is known as *fruit salad plant* in Fiji. As elsewhere, it is used as an ornamental; the pulp of the fruit is edible and has a pineapple-like fragrance, after the shedding of the trichosclereid-filled upper styler portion which proceeds gradually upward from the bottom of the spadix.

The species is easily recognized by its winged geniculum and its large, cordate leaves with strikingly large holes.

2. *EPIPREMNUM* Schott in Bonplandia 5: 45. 1857, Gen. Aroid. t. 79. 1858; Engl. & Krause in Pflanzenr. 37 (IV. 23B): 54. 1908; Nicolson in Allertonia 1: 345. 1978.

Somewhat woody root climbers; spathe deciduous, full of trichosclereids; spadix covered with flowers, these naked, bisexual, with 4 stamens; pistil with vertically oriented linear stigma; ovary unilocular with one lateral placenta bearing 2-8 ovules near base; seeds rather large, reniform, smooth, curved.

TYPE SPECIES: *Epipremnum mirabile* Schott (= *E. pinnatum* (L.) Engl.).

DISTRIBUTION: Probably fewer than 30 species occurring from the Himalayas into Oceania. I have recently (in *Allertonia* 1: 345-346, 1978) discussed the taxonomy and nomenclature of this generic name and its potential confusion with *Rhaphidophora* Hassk.

1. *Epipremnum pinnatum* (L.) Engl. in Engl. & Krause in *Pflanzenr.* 37 (IV, 23B): 60, fig. 25; *t.* 1, fig. B. 1908; Merr. *Intrepret. Rumph. Herb. Amb.* 127. 1917; Christophersen in *Bishop Mus. Bull.* 128: 39. 1935; Yuncker in op. cit. 184: 28. 1945, in op. cit. 220: 75. 1959; J. W. Parham, *Pl. Fiji Isl.* 267. 1964, ed. 2. 362. 1972. FIGURE 87.

Pothos pinnata L. *Sp. Pl.* ed. 2. 1374. 1763.

Monstera pinnata Schott in *Weiner Z. Kunst* 4: 1028. 1830.

Rhaphidophora pinnata Schott in *Bonplandia* 5: 45. 1857, in *J. Bot.* 1: 205. 1863; Backer & Bakh. f. *Fl. Java* 3: 107. 1968.

Epipremnum mirabile Schott, *Gen. Aroid. t.* 79. 1858; N. E. Br. in *J. Bot.* 20: 332. 1882.

Rhaphidophora vitiensis Schott (ex Seem. in *Bonplandia* 9: 260, as *Raphidophora* v., nom. nud. 1861), in *Bonplandia* 9: 367. 1861; Seem. *Viti*, 444, as *Raphidophora* v. 1862, *Fl. Vit.* 286. 1868.

Rhaphidophora pertusa var. *vitiensis* Engl. in *DC. Monogr. Phan.* 2: 244. 1879; Drake, *Ill. Fl. Ins. Mar. Pac.* 326, as *Raphidophora* p. var. v. 1892.

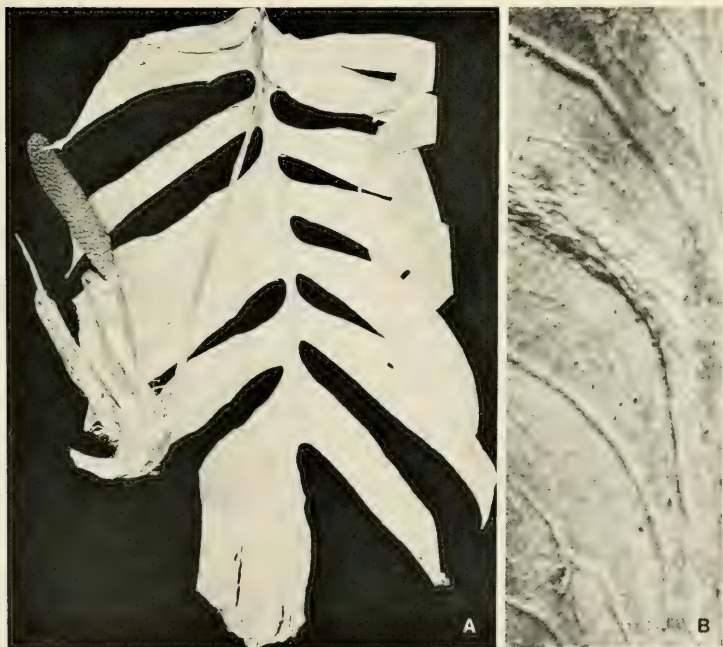


FIGURE 87. *Epipremnum pinnatum*: A, Leaf and inflorescence, the spathe fallen, $\times 1/4$, from Smith 1298; B, detail of lower surface of leaf blade, showing lateral nerves leaving the costa, $\times 10$, from Meebold 16773.

High-climbing liana; sheath soon withering but leaving a mat of intertwined venation; blade pinnatisect (adult) to entire (juvenile), to 1×0.5 m., often with tiny perforations along midrib; spathe cream, soon withering; spadix sessile, to 17×3 cm.

TIPIFICATION AND NOMENCLATURE: The description and figure of *Adpendix laciniata* Rumph. (Herb. Amb. 5: 489. t. 183, fig. 2. 1747) provide the sole basis of *Pothos pinnata*. *Epipremnum mirabile* is based on a plant from Java. *Rhaphidophora vitiensis* is typified by Seemann 654, for which Schott did not indicate a depository; however, the κ sheet is doubtless the holotype; Seemann's field notes indicate that he obtained it on Taveuni, although he observed it also on several other islands. A more extensive synonymy is provided in the 1908 publication of Engler and Krause.

DISTRIBUTION: Southeastern Asia through Malesia and into Oceania, occasionally cultivated and naturalizing.

KEY TO INFRASPECIFIC TAXA

- Leaves not variegated. 1a. *E. pinnatum*
 Leaves variegated. 1b. *E. pinnatum* cv. 'Aureum'

1a. *Epipremnum pinnatum*

DISTRIBUTION: As noted above. In Fiji it is often locally abundant at elevations from near sea level to 1,100 m., in various types of forest, on the edges of mangrove swamps, and in thickets. It has been collected in flower between March and September and in fruit practically throughout the year. About 35 collections are available, but the species is more frequent than this would indicate.

LOCAL NAMES AND USES: Many different Fijian names have been recorded for this species, *yalu* being the most universal. Other recorded names are *wa yalu*, *wa lu*, *alu*, *halu*, *waloa*, *matha*, *nanggalanggala*, *nanggalinggali*, *tonga*, and *tanga*. It is reported to furnish a medicine for "aches." N.E. Brown (in J. Bot. 20: 332-337. 1882) presents an interesting account of the Fijian medicine called *tonga*, which is composed of crushed leaves and stems of *Epipremnum pinnatum* and *Premna taitensis*. The species is widely cultivated as an ornamental in the Pacific east of the Fijian Region, as well as in other parts of the world.

REPRESENTATIVE COLLECTIONS: YASAWAS: WAYA: Naruarua Gulch, west of Mbatinaremba, St. John 18056. VITI LEVU: MBA: Hills near Lautoka, Greenwood 412; Mt. Nanggaranambuluta, east of Nandarivatu, Smith 4836. NANDRONGA & NAVOSA: Nausori Highlands, O. & I. Degener 32350; above Thotho Levu, H. B. R. Parham 107. SERUA: Between Navua River and Wainiyavu Creek, near Namuamua, Smith 9011. NAITASIRI: North of Suva, Gillespie 3495. TAILEVU: Vicinity of Korovou, DA 11430; Mburetu, DA 895. REWA: Viwa Island, Harvey; vicinity of Suva, Meebold 16773. KANDAVU: Namalata isthmus region, Smith 10. OVALAU: Mt. Koronimoko, vicinity of Thawathi, Smith 8088. NGAU: Hills east of Herald Bay, inland from Sawaieke, Smith 7974. VANUA LEVU: MATHUATA: Mt. Numbuiloo, east of Lambasa, Smith 6378. TAVEUNI: Vicinity of Waiyevo, Smith 8108. TOTOYA: Bryan 360. VANUA MBALAVU: Slopes of Korolevu, near Lomaloma, Garnock-Jones 1036. LAKEMBA: Near airport, Garnock-Jones 866. KAMBARA: On limestone formation, Smith 1298.

1b. *Epipremnum pinnatum* cv. 'Aureum'; Nicolson in Allertonia 1: 347. 1978.

Pothos aurea Linden & André in Ill. Hort. 27: 69. t. 381. 1880.

Scindapsus aureus Engl. in Engl. & Krause in Pflanzenr. 37 (IV. 23B): 80. 1908; J. W. Parham, Pl. Fiji Isl. 267. 1964, ed. 2. 363. 1972.

Rhaphidophora aurea Birdsey in Bailey 10: 159. fig. 49, 50. 1962; Furtado in Gard. Bull. Singapore 20: 379. 1964.

Epipremnum aureum Bunting in Ann. Missouri Bot. Gard. 50: 28. 1963.

Similar to *Epipremnum pinnatum* except for the leaves being variegated with yellow and more irregularly and shallowly pinnatifid in the adult aspect.

TIPIFICATION: In the original publication Linden and André indicate that their description was based on a plant received from the Solomon Islands by Linden; their illustration (*t. 381*, cited above) may be considered the type.

DISTRIBUTION: This taxon probably arose as a variegated sport from *Epipremnum pinnatum* in its natural distribution.

USE: Although Parham, cited above, states that this plant is a common introduced ornamental, no collections were listed. However, one does exist.

AVAILABLE COLLECTION: KAMBARA: Moore 24 (US, sterile juvenile).

This plant has hitherto been treated as a species. It rarely flowers; indeed, it has been called the *money plant* because of a tradition that its owner will become rich if it flowers. Birdsey (1962, cited above) seems to have been the first to publish on its flowering and to have described the floral characters of *Epipremnum pinnatum*, which is a very variable taxon when viewed throughout its range; *E. aureum* falls within this variability, except for the distinctive characteristic of having variegated leaves. A further commentary is made in my 1978 discussion, cited above.

3. RHAPHIDOPHORA Hassk. in *Flora* 25: Beibl. 1: 11. 1842; Seem. *Fl. Vit.* 286, p. p. 1868; Engl. & Krause in *Pflanzenr.* 37 (IV. 23B): 17. 1908.

Cuscutaria sensu Seem. *Fl. Vit.* 287. 1868; non Schott.

Suffrutescent climbers; spathe deciduous, full of trichosclereids; spadix covered with flowers, these bisexual, naked, with 4 stamens; pistil unilocular (sometimes partially bilocular) with 2 intrusive placentae with many anatropous ovules; seeds many, small, oblong.

TYPE SPECIES: *Rhaphidophora lacera* Hassk., nom. illeg. incl. *Pothos pertusa* Roxb. (= *R. pertusa* (Roxb.) Schott).

DISTRIBUTION: Africa, southern Asia, and eastward into Oceania. Sixty species were recognized in the last revision (Engl. & Krause, cited above), and more than 70 have been added since then. The number is certainly less if one accepts a greater degree of variability in vegetative characteristics.

The spelling of the generic name, *Rhaphidophora* vs. *Raphidophora*, is discussed as an Editor's Note by William J. Dress (in *Baileya* 10: 159. 1962). The spelling *Rhaphidophora* appeared first and is quite acceptable; it is not considered "correctable" to *Raphidophora*, the spelling used by Hasskarl later (*Cat. Pl. Hort. Bogor.* ed. 2. 58. 1844) and by some other authors.

The taxonomic distinctiveness of this taxon from the taxon called *Epipremnum* is controversial, as is the typification of the generic name. I have recently (in *Allertonia* 1: 345-346. 1978) discussed the complex details. The Leningrad Congress (1975) authorized a Committee to report to the next International Botanical Congress what it considers the ICBN might better say concerning the typification of generic names. Depending on the outcome, either *Pothos pertusa* will have to be recognized as the type species or it will be proposed as a conserved type species in order to maintain the historical usages of Schott and Engler. In the present treatment I have not listed separately the spellings *Rhaphidophora* and *Raphidophora* as used by different authors.

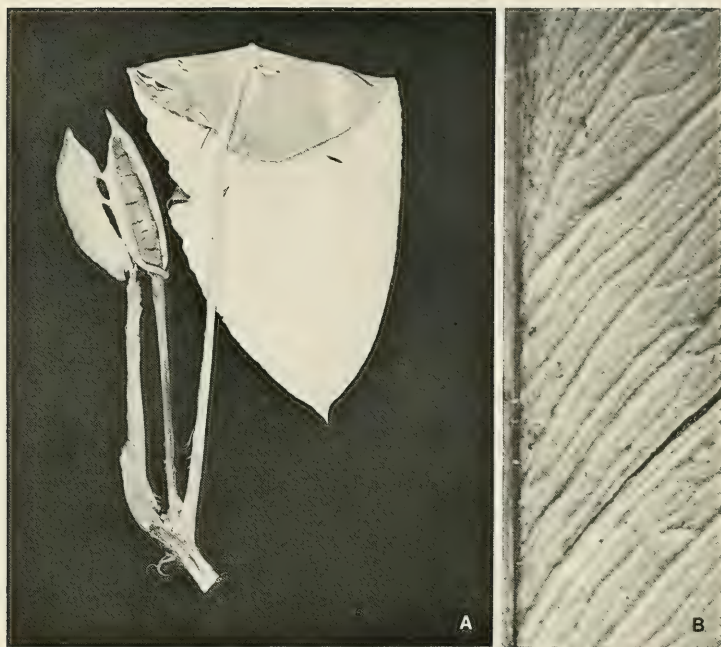


FIGURE 88. *Rhaphidophora spuria*; A, Leaf and inflorescence, the spathe split open, the long terminal bud of the stem present, $\times 1/4$, from Smith 8653; B, detail of lower surface of leaf blade, showing lateral nerves leaving the costa, $\times 10$, from Gillespie 2198.

1. *Rhaphidophora spuria* (Schott) Nicolson in Allertonia 1: 348. 1978. FIGURE 88.

Cuscuaria spuria Schott ex Seem. in Bonplandia 9: 260, nom. nud. 1861; Schott in Bonplandia 9: 367 (descr.) 1861; Seem, Viti, 444. 1862, Fl. Vit. 287. 1868.

Aroidea Seem. in Bonplandia 10: 297. 1862, Viti, 444. 1862.

Rhaphidophora storckiana Schott in Bonplandia 10: 346. 1862; Seem. Fl. Vit. 287. 1868; Engl. & Krause in Pflanzenr. 37 (IV. 23B): 43. 1908; J. W. Parham, Pl. Fiji Isl. 267. 1964, ed. 2. 363. 1972.

Rhaphidophora peepla var. *storckiana* Engl. in DC. Monogr. Phan. 2: 243. 1879; Drake, Ill. Fl. Ins. Mar. Pac. 326. 1892.

Cuscuaria marantifolia sensu Engl. in DC. Monogr. Phan. 2: 252, quoad syn. *C. spuria*. 1897; non Schott.

Scindapsus cuscuaria sensu Drake, Ill. Fl. Ins. Mar. Pac. 326. 1892; Engl. & Krause in Pflanzenr. 37 (IV. 23B): 68, quoad syn. *Cuscuaria spuria*. 1908; J. W. Parham, Pl. Fiji Isl. 267. 1964, ed. 2. 363. 1972; non Presl.

Epiphytic root-climber; petiole 20–30 cm. long, with withering sheath to geniculum; blade 25–40 \times 10–20 cm., ovate-oblong, rounded at base, acute to obtuse at apex; venation weakly differentiated below into primary veins about 1 cm. apart, undifferentiated above; spathe cream, 9–12 cm. long, soon deciduous; spadix sessile, 8–10 \times 1.5 cm., cream-white at anthesis; stigmas punctate.

TIPIFICATION AND NOMENCLATURE: *Cuscuaria spuria* is typified by Seemann 655 (K HOLOTYPE) from Viti Levu (on κ sheet) without further locality. Storek 911 (κ), from Ovalau, is the holotype of *Rhaphidophora storckiana*. Although the specimen of *C. spuria* is sterile and consists of a single leaf, it falls within the vegetative variability of what has been called *R. storckiana*, and the older available epithet must be adopted.

DISTRIBUTION: Apparently endemic to Fiji, but very similar to *Rhaphidophora graeffei* Engl. and *R. reineckeae* Engl., of Samoa, and possibly including them. In establishing *R. storckiana*, Schott indicated a similarity to *R. peepla* (Roxb.) Schott, regarded as an east Asian taxon by Engler and Krause (in *Pflanzenr.* 37 (IV. 23B): 41–42. 1908) but redefined by Furtado (in *Gard. Bull. Singapore* 8: 150–152. 1935) with some confusion, apparently as an endemic of northeastern India. The final circumscription of *R. spuria* awaits revision of *Rhaphidophora*, but in the meantime it may be considered a Fijian endemic, occurring from near sea level to 600 m. in dense forest. Flowers and fruits have been noted from June to November. It is doubtless more abundant than suggested by the 17 available collections.

LOCAL NAMES: *Yalu* is the usual name, but *matha* has also been noted; both these names are also used for *Epipremnum pinnatum*.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Vicinity of Nalotawa, eastern base of Mt. Evans Range, *Smith* 4443. NAMOSI: Northern base of Korombasambasanga Range, in drainage of Wainavindrau Creek, *Smith* 8653; vicinity of Namosi, *Gillespie* 2515; vicinity of Namuamua, *Gillespie* 3053, *Smith* 8947; Nambukavesi Creek, *DA* 11590. NAITASIRI: Between Viria and Nasonggo, *Parks* 20444; Tholo-i-suva, *DA* 11246, p. p., 11563, p. p.; Tamavua woods, *Gillespie* 2198, 2469. REWA: Vicinity of Suva, *Meebold* 16774. KANDAVU: Namalata isthmus region, *Smith* 29. VANUA LEVU: MATHUATA: Seangangga District Farm, *DA* 13578. THAKAUNDROVE: Southern slope of Mt. Mariko, *Smith* 402.

4. *ANTHURIUM* Schott in Weiner Z. Kunst 3: 828. 1829; Engl. in *Pflanzenr.* 21 (IV. 23B): 53. 1905.

Subherbaceous perennials, sometimes climbing; petioles shortly sheathing at base, with tumid geniculum at apex; leaf blades various, from simple to radiately compound, the venation reticulate; spathe persistent, spreading, sometimes brightly colored; flowers bisexual, each with 4 overarching and persistent tepals; stamens 4; ovary bilocular with 1 (rarely 2) subapically attached ovules per locule; berry fleshy, usually with 1 oblong seed with fleshy albumen.

LECTOTYPE SPECIES: *Anthurium acaule* (Jacq.) Schott (*Pothos acaulis* Jacq.); vide Britton & Wilson, *Sci. Surv. Porto Rico* 5: 128. 1923.

DISTRIBUTION: *Anthurium* is the largest genus in the family, with about 750 species in the neotropics. Many of these are cultivated, some for foliage and others for their bright inflorescences. Only one species has been noted in Fiji.

1. *Anthurium andraeanum* Linden in Ill. Hort. 24: 43. pl. 271. 1877; Engl. in *Pflanzenr.* 21 (IV. 23B): 241, as *A. andreanum*. 1905; J.W. Parham, *Pl. Fiji Isl.* 266. 1964, ed. 2. 360, as *A. andreanum*. 1972.

Stem short, erect; leaf blade cordate, 15–20 × 7–12 cm.; peduncle longer than petioles; spathe leathery, brilliant (usually red but shades through yellowish to white in cultivation), cordate, usually more than 10 × 10 cm.; spadix sessile, de-curved, also brightly colored.

TIPIFICATION AND NOMENCLATURE: Linden based the taxon on a cultivated plant originally collected by E. André in 1876 in El Chocó Province, Colombia. His latinization of André to *Andraeus* (neuter adj. form, *andraeanum*) is irregular but per-

fely correct, as exemplified by the latinization of Linné to *Linnaeus* (neuter adj. form, *linnaeanum*).

DISTRIBUTION: Andes of southern Colombia and northern Ecuador, now widespread in cultivation among commercial growers.

LOCAL NAME AND USE: *Anthurium*; cultivated as an ornamental for its showy inflorescences.

AVAILABLE COLLECTION: VITI LEVU: NAITASIRI: Toninaiwau, Tholo-i-suva, DA 16711. This single collection, of course, does not give a real picture of the cultivation of the species in Fiji.

5. *Zantedeschia* Spreng. Syst. Veg. 3: 756, 765. 1826; Engl. in Pflanzenr. 64 (IV. 23Dc): 61. 1915; Letty in Bothalia 11: 5. 1973. Nom. cons.

Colocasias Link, Diss. Bot. 77. 1795. Nom. rej. vs. *Colocasias* Schott (1832).

Richardia Kunth in Mém. Mus. Hist. Nat. 4: 433, 437. t. 20. 1815; non L.

Acaulescent, rhizomatous herbs; leaves cordate-hastate to lanceolate with striate venation; peduncles longer than leaves; spathe showy, white to pink or yellow, persistent, with margins overlapping at base; spadix with upper three-quarters covered with more or less free stamens; pistillate flowers usually naked (sometimes with staminodia), the ovary 2-5-locular with about 4 ovules per locule in 2 series along middle of the axillary placenta, the testa longitudinally striate.

TYPE SPECIES: *Zantedeschia aethiopica* (L.) Spreng. (*Calla aethiopica* L.).

DISTRIBUTION: Six species of southern Africa, several of them commonly cultivated.

The genus was apparently named for Giovanni Zantedeschi (1773-1846), a Brescian botanist, and not, as often credited, for Francesco Zantedeschi (1797-1872), a physicist. This generic name was originally conserved against *Aroides* Heister ex Fabric. (Enum. Meth. Pl. ed. 2. 42. 1763); see Rickett & Stafleu in Taxon 8: 231. 1959, and previous editions of the ICBN. But Fabricius included *Calla palustris* L., the lectotype species of *Calla* L. (1753) in his genus *Aroides*, and therefore that generic name must be regarded as a superfluous renaming of *Calla* L. Thus the conservation of *Zantedeschia* was unnecessary, since there is nothing against which it needs to be conserved, but the name is kept on the list in Appendix III of the ICBN.

1. *Zantedeschia aethiopica* (L.) Spreng. Syst. Veg. 3: 765. 1826; Engl. in Pflanzenr. 64 (IV. 23Dc): 62. fig. 28. 1915; J.W. Parham, Pl. Fiji Isl. 267. 1964, ed. 2. 363. 1972; Letty in Bothalia 11: 9. 1973.

Calla aethiopica L. Sp. Pl. 968. 1753.

Plants evergreen, to 1.5 m. tall; leaf blades 15-20 × 10-15 cm., ovate-cordate to hastate; spathe ivory-white, widely spreading and arching back, greenish on outside and without a purple spot at base on inside; spadix bright yellow; ovaries green, with interspersed whitish staminodes.

LECTOTYPIFICATION: As lectotype a specimen in Hort. Cliff. Herb. (BM) has been chosen, a photo being reproduced by Letty (in Bothalia 11: 7. fig. 3. 1973).

DISTRIBUTION: Native to South Africa (Cape, Natal, and Transvaal Provinces) and Lesotho, but now widely cultivated and naturalizing in wet subtropical situations. No collections are available from Fiji, but the plant obviously occurs there in cultivation, as recorded by Parham.

LOCAL NAMES AND USE: *Arum lily* is the name recorded by Parham, but perhaps *calla lily* is the more common name. It is cultivated as an ornamental, having been introduced into Fiji in the 1880's.

6. *AMORPHOPHALLUS* Bl. (in Batav. Courant, Nov. 23, 1825, descr. sed sine nom.); Bl. ex Dec. in Nouv. Ann. Mus. Hist. Nat. 3: 366. 1834 (repr. Herb. Timor. Descr. 38. 1835); Seem. Fl. Vit. 283. 1868; Engl. in Pflanzenr. 48 (IV. 23C): 61. 1911. Nom. cons.

Pythion Mart. in Flora 14: 458. 1831. Nom. rej.

Candarium Reichenb. Consp. Reg. Veg. 44, nom. nud. sect. *Ari*. 1828; Reichenb. ex Schott in Schott & Endl. Melet. Bot. 17, nom. illeg. 1832.

Tuberous herb with a single, deciduous leaf, usually produced after the inflorescence; leaf blade trisect at base, each segment somewhat dichotomously branching into a compound leaf; spathe withering but persistent, clasping; flowers unisexual, nude; spadix divided into 3 parts: the lower pistiliferous part, the medial part with densely packed anthers, and the terminal naked appendix; pistils 1–4-locular with 1 ovule per locule, this usually basal; seeds smooth.

TYPE SPECIES: *Amorphophallus campanulatus* (Roxb.) Bl. ex Dec. (*Arum campanulatum* Roxb.). (But cf. Nicolson in Taxon 26: 337. 1977.)

DISTRIBUTION: About 100 species in tropical and subtropical Africa and Asia and eastward into the Pacific islands.

1. *Amorphophallus paeoniifolius* (Dennst.) Nicolson in Taxon 26: 338. 1977.

FIGURES 89, 90.

Dracontium paeoniaefolium Dennst. Schlüs. Hort. Malabar. 13, 21, 38. 1818; Manitz in Taxon 17: 499. 1968.

Arum campanulatum Roxb. (Hort. Beng. 65, nom. nud. 1814), Pl. Coromandel 3: 68. t. 272, nom. illeg. 1820.

Arum rumphii Gaud. Voy. Uranie et Physicienne, Freycinet, Bot. 43. t. 39, nom. illeg. 1827, op. cit. 427, nom. illeg. 1829.

Amorphophallus campanulatus Bl. ex Dec. in Nouv. Ann. Mus. Hist. Nat. 3: 366. 1834 (repr. Herb. Timor. Descr. 38. 1835); Bl. Rumphia 1: 139. t. 32, 33. 1837; Seem. Fl. Vit. 283. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 325. 1892; Engl. in Pflanzenr. 48 (IV. 23C): 76. 1911; Christophersen in Bishop Mus. Bull. 128: 40. 1935; Yuncker in op. cit. 178: 28. 1943, in op. cit. 184: 28. 1945; A. C. Sm. in Sci. Monthly 73: 14. fig. 1951; Barrau in Bishop Mus. Bull. 219: 43. 1958; J. W. Parham in Dept. Agr. Fiji Bull. 35: 147. 1959, Pl. Fiji Isl. 265. 1964, ed. 2. 360. fig. 99. 1972; Backer & Bakh. f. Fl. Java 3: 111. 1968.

Amorphophallus dubius Bl. Rumphia 1: 142. 1837; Engl. in Pflanzenr. 48 (IV. 23C): 74. 1911.

Amorphophallus giganteus Bl. Rumphia 1: 144, nom. illeg., non sensu Bl. t. 34 et auct. subseq. 1837.

Amorphophallus sativus Bl. Rumphia 1: 145. 1837; Engl. in Pflanzenr. 48 (IV. 23C): 109. 1911.

Amorphophallus ? Seem. in Bonplandia 9: 260. 1861, Viti, 444. 1862.

Plesmonium nobile Schott in Ann. Mus. Bot. Lugd.-Bat. 1: 279. 1863; Engl. in Pflanzenr. 48 (IV. 23C): 51. 1911.

Amorphophallus rex Prain in J. Asiat. Soc. Bengal 62: 79. (Aug. 12) 1893; Hook. f. Fl. Brit. Ind. 6: 514. (Sept.) 1893; Engl. in Pflanzenr. 48 (IV. 23C): 75. 1911.

Tuber annually replaced, up to 30 cm. in diameter; herb with a single basally trisect decompound leaf appearing after the inflorescence; petiole mottled, rough or smooth; inflorescence on short (to 10 cm. long) peduncle; spathe greenish outside, purplish inside, the margin at first erect, then spreading, finally drooping; naked appendix purplish, conoidal, broadest below, commonly furrowed, fibrously hollow inside, less than twice as long as broad; stamens with purple filaments and yellow anthers; styles purple, 3–4 times longer than ovary; stigma deeply lobed, yellow.

TYPOIFICATION AND NOMENCLATURE: The type is *Mulen-Schena Rheede*, Hort. Ind. Malabar. 11: 37. t. 19. 1692. The existence and significance of the earliest available name, *Dracontium paeoniaefolium* Dennst., has largely been overlooked, although Backer and Bakhuizen van den Brink (Fl. Java 3: 111. 1968) realized that it affected *Amorphophallus giganteus* Bl. According to my understanding of the thrust of Art. 63 on superfluous names and Art. 7 (automatic typification of superfluous names), ICBN, the following names are also typified by *Mulen-Schena Rheede*: *Arum campanulatum* Roxb., *Arum rumphii* Gaud., and *Amorphophallus giganteus* Bl. *Amor-*



FIGURE 89. *Amorphophallus paeoniifolius*, from Smith 6341; leaves.



FIGURE 90. *Amorphophallus paeoniifolius*, from Smith 6341; inflorescence.

phophallus campanulatus Bl. ex Dec. is legitimate, as a new name under the provisions of Art. 72 (Note), ICBN, but not as a new combination; the type is *Gaudichaud s. n.* (P), from Timor. *Amorphophallus sativus* Bl. is typified by *Tacca sativa* Rumph. (Herb. Amb. 5: 324. 1747). The type of *Plesmonium nobile* Schott is *DeVriese s. n.* (L), from Java, not from Ceram as reported. The type of *Amorphophallus rex* Prain is *Prain (?) 111*, from Narcondam, Andaman Islands; it should be noted that Prain actually published his name a month before Hooker used it as a "mss." name. The entities here discussed are all doubtless conspecific with the plant so well known as *A. campanulatus* (Roxb.) Bl. ex Dec.

DISTRIBUTION: Widespread from the Malagasy Republic through India and out into the Pacific. The plant is cultivated as a starch source, sometimes as a novelty, and as it often naturalizes its nativity is speculative. Apparently it rarely fruits in India, suggesting a more easterly origin. In Fiji it was probably an aboriginal introduction, now naturalized and occurring from near sea level to 350 m. in various types of forest and in pastures, usually in dry places, and sometimes as a minor weed in plantations. Collections are few (probably because of the difficulties involved), and flowers have been noted only in October and November.

LOCAL NAMES AND USE: The usual Fijian name is *ndainga*, but *ndangava* and *suran* have also been recorded. The tuber is acrid when fresh but edible when cooked by special methods, usually by baking into bread (*mandrai*); although of high food value it is now considered an emergency food. Seemann's account (Fl. Vit. 283-284. 1868) of the plant is of exceptional interest.

AVAILABLE COLLECTIONS: VITI LEVU: REWA: Suva, Government Domain, *Tothill 547A*. OVALAU: Near Levuka, *Degener & Ordenez 13992*. MOTURIKI: *Seemann 652* (on K sheet, but Taveuni in Fl. Vit.). VANUA LEVU: MATHUATA: Southern slopes of Mt. Numbuiloa, east of Lambasa, *Smith 6341*. VANUA MBALAVU: Northern limestone section, *Smith 1510*. FIJI without further locality, *U.S. Expl. Exped.*

This is an easy species to recognize by its single trifurcate and decompound leaf about 1 m. across, or by its bulbous, purple, and stinking inflorescence. The characters used to segregate "species" similar to this are of little value. The ratio of floriferous to naked parts of the spadix varies as the inflorescence matures, as does the ratio of the spathe to the spadix length. The general size of a given plant (leaf or inflorescence) varies as the size of the annually replaced tuber varies, usually becoming bigger. An excellent, but early, reference on the biology and poisonous principle of the species is provided by Kirkitar (in J. Bombay Nat. Hist. Soc. 9: 42-60. 1894).

7. CYRTOSPERMA Griffith, Notul. Pl. Asiat. 3: 149. 1851, Icon. Pl. Asiat. 3: t. 169. 1851; Seem. Fl. Vit. 287. 1868; Engl. in Pflanzenr. 48 (IV. 23C): 14. 1911.

Aperoea Moerenhout, Voy. Isl. Grand Ocean 2: 96, nom. nud. 1837. (Correctly *Apeveoa*, from native name *apé veo*.)

Arisacontis Schott in Bonplandia 5: 129. 1857.

Robust herbs from a short or tuberous caudex; petiole and peduncle commonly prickly or warty; leaf blade hastate-sagittate, the venation reticulate; spathe open to base, persistent; spadix stipitate, with stipe adnate to spathe, or sessile, densely covered with bisexual 2- or 3-merous flowers with 4-6 tepals and stamens; ovary shortly attenuate above, unilocular, with 1, 2, or more ovules on a subbasal or parietal placenta; berry usually 1-seeded; seed subreniform, often crested.

TYPE SPECIES: *Cyrtosperma lasioides* Griffith ('*lacioides*'). The type species of *Aperoea* is *A. esculenta* Moerenhout, nom. nud. *Arisacontis* is typified by *A. chamissonis* Schott.

DISTRIBUTION: Tropical America (sect. *Polytomophyllum*), Africa (sect. *Lasiorhiza*), and from Malesia into Oceania, with about 15 species.

1. *Cyrtosperma chamissonis* (Schott) Merr. in Philipp. J. Sci. Bot. **9**: 65. 1914; Barrau in J. Agr. Trop. Bot. Appl. **4**: 36. 1957, in Bishop Mus. Bull. **219**: 42. 1958, in op. cit. **223**: 39. 1961; J.W. Parham, Pl. Fiji Isl. ed. 2. 362. 1972; Loumala in J. Polynes. Soc. **83**: 14. 1974.

Arisacontis chamissonis Schott in Bonplandia **5**: 129. 1857.

Arum sagittaeifolium Cham. ex Schott in Bonplandia **5**: 129, pro syn. 1857.

Cyrtosperma edulis Schott ex Seem. in Bonplandia **9**: 260, nom. nud. 1861; Schott in Bonplandia **9**: 367. 1861; Seem. Viti, 444. 1862, Fl. Vit. 287. 1868; B.E.V. Parham in Agr. J. Dept. Agr. Fiji **13**: 41. 1942.

Cyrtosperma merkusii sensu Drake, Ill. Fl. Ins. Mar. Pac. 326. 1892; non Schott.

Cyrtosperma edulis var. *gigantea* Nadeaud in J. Bot. (Morot) **11**: 116. 1897.

Cyrtosperma edule Schott ex Engl. in Pflanzenr. **48** (IV, 23C): 17, fig. 6. 1911; J.W. Parham, Pl. Fiji Isl. 267. 1964.

Cyrtosperma nadeaudianum J. W. Moore in Bishop Mus. Bull. **102**: 22. 1933.

Large acaulescent herb from underground tuber, this becoming massive with age; leaves hastate to sagittate on petioles to 2 m. long, unarmed or with a few prickles on petioles and peduncles; spathe yellowish with green veins; spadix yellow to orange.

TYPIFICATION AND NOMENCLATURE: The type of *Arisacontis chamissonis* is *Chamisso 54* (W HOLOTYPE), from the Radack Islands (Ratak Group of the Marshall Islands in modern usage). *Cyrtosperma edule* ('*edulis*' as first published) is typified by *Seemann 653* (K presumable HOLOTYPE), from Viti Levu without further data, Fiji. The type of *C. merkusii* var. *gigantea* (sic) and *C. nadeaudianum* is presumably a Nadeaud specimen (P presumable HOLOTYPE), from Raiatea, Society Islands. *Cyrtosperma* is badly in need of revision, and until the taxonomy is better understood the nomenclature is subject to change. Roughly speaking, the Oceanic materials are commonly called *C. chamissonis* (including *C. edule* and *C. nadeaudianum*), the materials from Indonesia and the Philippines are commonly called *C. merkusii* (Hassk.) Schott, and those from Malaya and Borneo are called *C. lasioides* Griffith. The large, almost unarmed Oceanic specimens are here maintained as a separate species. Collections from the Philippines, presently called *C. merkusii*, appear to be more similar to the Oceanic taxon than to the Javanese taxon. Study of admittedly inadequate numbers of specimens with seeds suggests that the Oceanic materials have smooth, uncrested seeds (see fig. 6 in the Engler 1911 reference listed above), while *C. merkusii* from Java and *C. lasioides* from Malaya, possibly conspecific, have seeds with 2 or 3 warty crests. Our understanding of the Asiatic and Oceanic taxa would be much enhanced by mastery of the materials from New Guinea, apparently a center of speciation for the genus. Study of chromosome numbers might reveal higher polyploid levels for the gigantic Oceanic and Philippine elements favored in cultivation.

DISTRIBUTION: Probably of aboriginal introduction into Oceania as a crop plant, now widely cultivated and probably naturalizing. The origin could be from wild stock in or around northern New Guinea, but this is entirely speculative. In Fiji it is frequently seen but seldom collected, in wet and swampy places near sea level, naturalized but also cultivated. Flowering and fruiting material has been obtained only in September.

LOCAL NAMES AND USES: Loumala (1974, cited above) reports 40 native names in Oceania. In Fiji *viakana* is the usual name, but *via* is sometimes used. The tuber is

edible when baked or boiled and is considered superior to that of *Alocasia*; it is a staple diet in the lower Rewa districts. Barrau (1961, cited above) reports a ten year old tuber weighing 160 pounds. Loumala's paper discusses the ethnological implications in the rituals of planting and harvesting.

AVAILABLE COLLECTIONS: VITI LEVU: TAILEVU: Mburetu, Ndaku, DA 881; Wainimbokasi area, photograph only (BISH) taken by W. R. B. Oliver, March 27, 1941.

8. *DIEFFENBACHIA* Schott in Wiener Z. Kunst 3: 803. 1829; Engl. in Pflanzenr. 64 (IV. 23Dc): 36. 1915.

Erect terrestrial herbs with thick stems; petiolar sheaths persistent; leaf blades subcordate to cuneate at base, with striate venation, often variegated; peduncle shorter than petiole; spathe oblong, persistent, constricted near middle, the margins overlapping below; spadix erect, the lower (pistillate) portion adnate to spathe, the upper (staminate) portion free; pistillate flowers loosely arranged, each subtended by 4 or 5 clavate staminodia, 1-3-locular with 1 subbasal anatropous ovule per locule; staminate flowers of 4 or 5 stamens fused into a subsessile, truncate syndrium; seeds globose to ovoid, smooth.

TYPE SPECIES: *Dieffenbachia seguine* (Jacq.) Schott ('*seguinum*') (*Arum seguine* Jacq.).

DISTRIBUTION: A neotropical genus of fewer than 30 species, some widely cultivated as ornamentals. One species is recorded from Fiji.

This distinctive and commonly cultivated genus is poorly understood because of its extreme plasticity, particularly in cultivation, where it has many distinctive cultivars. Engler, in the 1915 paper cited above, states the problem (in translation from Latin): "The species of *Dieffenbachia* are difficult to distinguish, moreover it is scarcely possible to determine herbarium specimens to species because the inflorescences do not give essential information, and furthermore the leaves on the same specimen differ in the length of the petiole, vagination, and the form and size of the blade in the juvenile and more advanced states. Moreover, almost the same forms of leaves occur in diverse species." Engler states that he relies on "texture and general color" of leaves, characters observable only in living specimens and of dubious value in defining species, as normally understood, but usual in defining cultivars.

1. *Dieffenbachia seguine* (Jacq.) Schott in Wiener Z. Kunst 3: 803, as *D. seguinum*. 1829; Schott & Engl. Melet. Bot. 20. 1832; Engl. in Pflanzenr. 64 (IV. 23Dc): 45. fig. 20, A-M, as *D. seguina*. 1915; Yuncker in Bishop Mus. Bull. 178: 28. 1943; J. W. Parham in Dept. Agr. Fiji Bull. 35: 146. 1959; Bunting in Baileya 10: 145. 1962; J. W. Parham, Pl. Fiji Isl. 267. 1964, ed. 2. 362. 1972.

Arum seguine Jacq. Enum. Syst. Pl. Carib. 31. 1760, Select. Stirp. Amer. 239. t. 151. 1763; L. Sp. Pl. ed. 2. 1371, as *A. seguinum*. 1763.

Caladium seguine Vent. Descr. Pl. Nouv. Jard. Cels, 30, nom. invalid. sine comb. 1801; Vent. ex Willd. Sp. Pl. 4: 490. 1805.

Caladium maculatum Lodd. in Bot. Cab. 7: t. 608. 1822.

Caladium seguinum var. *maculatum* Sims in Bot. Mag. 52: t. 2606. 1825.

Dieffenbachia maculata G. Don in Sweet, Hort. Brit. ed. 3. 632, as *D. maculatum*. 1839; Bunting in Baileya 11: 3. 1963.

Dieffenbachia picta Schott in Oesterr. Bot. Wochenbl. 2: 68. 1852, Syn. Aroid. 129. 1856, Prodr. Syst. Aroid. 332. 1860; Engl. in Pflanzenr. 64 (IV. 23Dc): 48. fig. 21. 1915; J. W. Parham, Pl. Fiji Isl. 267. 1964, ed. 2. 362. 1972.

Perennial herb with stem to 1 m. high; leaves variegated with many striking patterns, commonly with cream spots or blotches, acute to subcordate at base; spathe green to pale yellow; berries ripening from green to yellow, finally red.

TIPIFICATION AND NOMENCLATURE: A type specimen of *Arum seguine* is not known to me. Jacquin (1760, listed above) cites a plate (*Arum caulescens, Cannae indicae foliis* Plumier, Descr. Pl. d'Amer. 41. t. 51, fig. h (see also t. 61). 1693). Jacquin, although he brought back much living material to Vienna, apparently collected little herbarium material. The plate published by Jacquin in 1763 (cited above) is only of the inflorescence and floral details. All of this can be considered as type material. The type locality is probably the French Antilles (Martinique or Guadeloupe). The type of *Caladium maculatum* is the 1822 plate of Loddiges. *Caladium 'seguinum'* var. *maculatum* should probably be construed as a new variety rather than a new combination, with Sims's plate as its type. A type specimen of *Dieffenbachia picta* is not known to me, but Schott's illustrations (Icon. Aroid. t. 24-27. 1857) represent his concept. The epithet *seguine* is a vernacular (Creole) word frequently applied to aroids in the French Antilles, sometimes written as *siguine*, *signin*, or *sijin*. This epithet, although an indeclinable vernacular name, is often erroneously treated as if it were a three-ending adjective in Latin.

DISTRIBUTION: Neotropical, with many ornamental cultivars, some naturalizing in tropical areas. In Fiji it is both cultivated and naturalized, sometimes becoming a minor weed of waste places, roadsides, and coconut plantations; fruits have been noted in April and July.

LOCAL NAME AND USE: *Dumb cane* (because the irritating sap causes swelling and paralysis of the tongue and other mucous membranes). It is widely used as an ornamental.

AVAILABLE COLLECTIONS: VITI LEVU: NAITARISI: Koronivia, DA 7962, 12129. REWA:Suva, By-Pass road, DA 11305, 11539.

Several authors have expressed doubt that *Dieffenbachia seguine* and *D. maculata* (often called *D. picta*) are distinct species but, maintaining previous usage, have refrained from uniting them (Birdsey, Cult. Aroids, 60. 1951; Jonker-Verhoef & Jonker in Acta Bot. Neerl. 2: 356. 1953; Bunting in Bailey 10: 145. 1962). These and other authors have given keys to separate these acknowledgedly polymorphic "species" (Engl. in Pflanzenr. 64 (IV. 23Dc): 38. 1915; Neal, Gard. Haw. 152. 1965; Backer & Bakh. f. Fl. Java 3: 117. 1968). The characters involved (glaucousness of the lower leaf surface in *D. maculata*; cordate-truncate leaf base in *D. seguine* vs. acutish base in *D. maculata*; primary veins 9-15 on both sides of the leaf midrib in *D. seguine* vs. 15-20 in *D. maculata*; petiole shallowly canaliculate in *D. seguine* vs. deeply canaliculate in *D. maculata*; etc.) are demonstrably false, useless, or at best dubious. I cannot find and am unable to devise a key that will separate the many cultivars and herbarium specimens, presently attributed to one or the other "species," into two distinct taxa. Therefore I treat these hitherto two polymorphic species as a single polymorphic species.

9. *ALOCASIA* (Schott) G. Don in Sweet, Hort. Brit. ed. 3. 631. 1839; Seem. Fl. Vit. 285. 1868; Krause in Pflanzenr. 71 (IV. 23E): 71. 1920; Nicolson in Taxon 12: 208. 1963. Nom. cons.

Colocasia subgen. *Alocasia* Schott in Schott & Endl. Melet. Bot. 18. 1832.

Herbs with hypogean or epigean stem with short internodes; leaves various, usually sagittate, cordate or peltate at base, the secondary veins arching from primary veins to become subparallel to primary lateral veins; spathe with 2 parts, the lower part clasping and persistent, the upper blade spreading and soon withering or de-

ciduous; spadix with 4 parts, a lower pistillate part, a contracted interstice covered with sterile, aborted flowers, a staminate portion, and an irregularly corrugated naked appendix; staminate flowers with stamens united into synandria; pistillate flowers naked, unilobular, with a few orthotropous basal ovules; berry with 1-few subglobose seeds.

LECTOTYPE SPECIES: *Alocasia cucullata* (Lour.) G. Don (*Arum cucullatum* Lour.).
Typ. cons.

DISTRIBUTION: About 50 species from Asia through southeastern Asia and Malasia into Melanesia; those cultivated for food or ornament are now widespread and somewhat adventive.

Specimens of the genus are sometimes confused with *Xanthosoma*, of which the inflorescence has no naked terminal appendix, and *Colocasia*, of which the pistillate flowers have many ovules and seeds.

KEY TO SPECIES

- Leaves small, less than 50 cm. long, cordate, peltate, the posterior lobes united for 1-2.5 cm.; spathe blue-green, cucullate; terminal appendix about one-third the length of spadix. 1. *A. cucullata*
Leaves large, typically well over 50 cm. long, sagittate, the posterior lobes free; spathe cream, deflexing; terminal appendix more than half the length of spadix. 2. *A. macrorrhiza*

1. *Alocasia cucullata* (Lour.) G. Don in Sweet, Hort. Brit. ed. 3. 631, as *A. cucullatum*. 1839; Schott in Oesterr. Bot. Wochenbl. 4: 410. 1854; Krause in Pflanzenz. 71 (IV. 23E): 77. fig. 12. 1920; Nicolson in Taxon 12: 208. 1963; J.W. Parham, Pl. Fiji Isl. ed. 2. 359. 1972.

Arum cucullatum Lour. Fl. Cochinch. 536. 1790, ed. Willd. 656. 1793; Roxb. Fl. Ind. ed. 2. 3: 501. 1832.

Herb with erect stem 3-6 cm. thick; petiole 20-85 cm. long, with persistent sheath; leaf blade 8-30 × 6-35 cm., the posterior lobes fused; peduncle 25-30 cm. long; spathe about 12 cm. long, bluish green, the lower part persistent, the upper part arching forward, withering with age; spadix about 10 cm. long, pistillate for 1.5-2.5 cm., the sterile interstice 2.5-3 cm., the staminate part 2.5-3.5 cm., bluish green, the appendix 2.5-3.5 cm., greenish, corrugated.

TYPEIFICATION AND NOMENCLATURE: No type is known but is to be sought, probably at BM or P; the type locality is in the suburbs of Canton, China. Merrill (in Trans. Amer. Philos. Soc. n. s. 24(2): 97. 1935), under the misapprehension that *Alocasia* does not have peltate leaves, suggests that Loureiro's taxon may be a *Colocasia* because Loureiro described the leaf as peltate. Loureiro's description of the berry as 4-seeded makes it certain that his taxon falls into *Alocasia*. Hu (in Dansk Bot. Arkiv 23: 432. 1968) reports that the Chinese name given by Loureiro, *chim mi yu* (pointed tail aroid), is still used in Chinese herb shops for fresh or dried material of the species as understood here.

DISTRIBUTION: Hu (1968, cited above) reports that this species is known only from cultivated material and is probably associated only with Chinese culture. N.E. Brown (in J. Linn. Soc. Bot. 36: 183. 1903) reported specimens from Hainan and Chungking (Szechuan). Krause (1920, cited above) reports it from Sri Lanka, India, and Burma. Further work is necessary, but Hu's theory sounds probable. In Fiji the taxon is known only from a single specimen that was naturalized along a trail, fruiting in June. The species was probably originally introduced into Fiji as an ornamental (although no herbarium vouchers support this) and then sparingly escaped.

LOCAL NAME AND USES: No Fijian name has been reported, but the Chinese name is mentioned above. The species is doubtless sometimes used as an ornamental, and

Hu (1968, cited above) reports that it has a "skillfully and carefully guarded" medicinal value.

AVAILABLE COLLECTION: VANUA LEVU: MBUA: Nasawana Village (on coast of Wainunu Tikina), DA 16955.

2. *Alocasia macrorrhiza* (L.) G. Don in Sweet, Hort. Brit. ed. 3. 631, as *A. macrorrhizon*. 1839; Drake, Ill. Fl. Ins. Mar. Pac. 326, 410. 1892; Krause in Pflanzenr. 71 (IV. 23E): 84. fig. 15. 1920; Christophersen in Bishop Mus. Bull. 128: 43. 1935; Furtado in Gard. Bull. Singapore 11: 252. 1941; Yuncker in Bishop Mus. Bull. 178: 30. 1943; Barrau in J. Agr. Trop. Bot. Appl. 4: 41. 1957, in Bishop Mus. Bull. 219: 43. 1958; Yuncker in op. cit. 220: 76. 1959; Barrau in op. cit. 223: 39. fig. 15. 1961.

Arum macrorrhizon L. Sp. Pl. 965. 1753.

Arum indicum Lour. Fl. Cochinch. 536. 1790, ed. Willd. 655. 1793; Roxb. Fl. Ind. ed. 2. 3: 498. 1832.

Colocasia indica Kunth, Enum. Pl. 3: 39. 1841.

Alocasia indica Spach, Hist. Nat. Vég. Phan. 12: 47. 1846; Schott in Oesterr. Bot. Wochenbl. 4: 410. 1854; Seem. in Bonplandia 9: 260. 1861, Viti, 444. 1862, Fl. Vit. 285. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 325. 1892; Krause in Pflanzenr. 71 (IV. 23E): 87. 1920; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 13: 41. 1942; J. W. Parham in Dept. Agr. Fiji Bull. 35: 146. 1959, Pl. Fiji Isl. 265. 1964, ed. 2. 359. 1972.

Large herb with erect stem to 1 m. long and to 20 cm. thick; petiole 75–130 cm. long, the sheath persistent, 25–95 cm. long; leaf blade with anterior lobe 25–120 × 20–90 cm., the posterior lobes often overlapping, 12–40 cm. long; peduncle 20–45 cm. long; spathe 13–35 cm. long, the upper 11–30 cm. deflexing and deciduous or withering; spadix 11–32 cm. long, the pistillate portion 1–2 cm. long, the sterile interstice 0.5–2 cm. long, the staminate portion white and 2–7 cm. long, the terminal appendix tan, 7.5–21 cm. long, corrugated.

TIPOFICATION AND NOMENCLATURE: The lectotype of *Arum macrorrhizon* is *Arum maximum macrorrhizon zeylanicum* Herm. (Parad. Bat. t. 73. 1698). Furtado (in Gard. Bull. Singapore 11: 244–257. 1941) pointed out that Linnaeus was incorrect when he characterized his species as acaulescent and with peltate leaves. A drawing in the Hermann Herbarium (BM) studied by Linnaeus was cited by Trimen (in J. Linn. Soc. Bot. 24: 149. 1887) as identical with the published drawing. I wish to thank Susan Sutton, of the British Museum, for sending me a copy of the drawing in the Hermann Herbarium. The type material of *Arum indicum* should be sought at BM or P, but there is no reason not to regard *Arum indicum sativum* Rumph. (Herb. Amb. 5: t. 106. 1747), cited by Loureiro, as a lectotype. The reader is referred to Furtado's 1941 discussion of the development of the erroneous idea that *Alocasia macrorrhiza* and *A. indica* are distinct species, due to the erroneous description by Linnaeus. Here, as in *Dieffenbachia*, *Colocasia*, and *Amorphophallus*, it makes sense to recognize a single variable species rather than to attempt to maintain two or more indistinguishable and also variable "species," especially when plasticity is shown in cultivation.

DISTRIBUTION: The place of origin of the species is problematic, but it is found from India and Sri Lanka through southeastern Asia and into the Pacific. In Fiji it was probably an aboriginal introduction, now abundantly naturalized in damp places and along river banks from near sea level to 600 m. or higher. It is much more common than the few available herbarium specimens suggest.

LOCAL NAMES AND USES: The usual Fijian names are *via* and *via nganga*, but the following have also been recorded: *viandindi*, *viandranu*, *viamila*, *viasori*, and *giant*

taro. It is considered a famine food. The rhizome is edible when thoroughly cooked, either by baking or by boiling in several changes of water, or grated and made into bread. The stem is reportedly used in treating earache in Namosi, heated sap being dripped into the affected ear.

AVAILABLE COLLECTIONS: VITI LEVU: NAMOSI: Near Namosi Village, *Weiner* 2. NAITASIRE: East of Lutu, Wainimala River, *St. John* 18374. REWA: Walu Bay, Suva, *R. A. Lever*, Dec. 27, 1943. FIJI without further locality, *Seemann* 651 (observed on Viti Levu, Vanua Levu, and Taveuni, according to *Flora Vitiensis*).

In living plants of *Alocasia macrorrhiza* the apex of the leaf tends to point up and the posterior lobes down; in the cultivated *Colocasia* this is reversed; and in *Xanthosoma* the leaf tends to be horizontal with the posterior lobes pointing up.

10. *COLOCASIA* Schott in Schott & Endl. Melet. Bot. 18. 1832; Seem. Fl. Vit. 284. 1868; Krause in Pflanzenr. 71 (IV. 23E): 62. 1920. Nom. cons.

Tuberous or caulescent herbs; leaf peltate, cordate to sagittate, the secondary veins confluent, forming a collective vein between and parallel to the primary lateral veins; lower spathe accrescent, the upper spathe much longer, soon lost; spadix in 4 parts, the lowest pistillate, the next sterile, the next staminate, and the uppermost a naked appendix; staminate flowers with 3–6 stamens united into synandria; pistillate flowers 3- or 4-carpellate, unilocular with many suborthotropous ovules on parietal placentae; berry oblong, many-seeded; seeds oblong, longitudinally grooved.

TYPE SPECIES: *Colocasia antiquorum* Schott (*Arum colocasia* L.). Typ. cons.

DISTRIBUTION: Fewer than ten species, presumed to have originated in southeastern Asia, but with one species aboriginally spread by cultivation through the Old World tropics. This is the only species occurring in Fiji.

1. *Colocasia esculenta* (L.) Schott in Schott & Endl. Melet. Bot. 18. 1832; Christophersen in Bishop Mus. Bull. 128: 40. 1935; B. E. V. Parham & Raiqiso in Agr. J. Dept. Agr. Fiji 10: 102. 1939; Hill in Bot. Mus. Leaflet. 7: 115. 1939; Yuncker in Bishop Mus. Bull. 178: 28. 1943, in op. cit. 184: 28. 1945; Barrau in J. Agr. Trop. Bot. Appl. 4: 44. 1957, in Bishop Mus. Bull. 219: 39. fig. 22, 23. 1958; Yuncker in op. cit. 220: 75. 1959; Barrau in op. cit. 223: 39. fig. 14. 1961; J. W. Parham, Pl. Fiji Isl. 266. fig. 93. 1964, ed. 2. 361. fig. 100. 1972.

Arum esculentum L. Sp. Pl. 965. 1753.

Arum colocasia L. Sp. Pl. 965. 1753.

Colocasia antiquorum Schott in Schott & Endl. Melet. Bot. 18. 1832, Syn. Aroid. 40. 1856, Prodr. Syst. Aroid. 138. 1860; Drake, Ill. Fl. Ins. Mar. Pac. 325. 1892; Krause in Pflanzenr. 71 (IV. 23E): 65. 1920; B. E. V. Parham in Agr. J. Dept. Agr. Fiji 13: 40. 1942.

Colocasia antiquorum var. *esculenta* Schott ex Seem. (in Bonplandia 9: 260. 1861, Viti, 444, nom. nud. 1862), Fl. Vit. 284. 1868; Engl. in DC. Monogr. Phan. 2: 492. 1879; Krause in Pflanzenr. 71 (IV. 23E): 67. 1920.

Colocasia esculenta var. *antiquorum* Hubbard & Rehder in Bot. Mus. Leaflet. 1: 5. 1932; Hill in op. cit. 7: 117. 1939.

Colocasia esculenta subsp. *antiquorum* Haudricourt in Rev. Bot. Appl. Agr. Trop. 21: 62. 1941.

Perennial herb cultivated for large underground tubers; leaves with posterior lobes 1/3–3/4 joined (peltate); spathe to 35 cm. long, the upper part deciduous and yellowish, normally 2 or more times longer than spadix; spadix with naked terminal appendage sometimes greatly reduced.

TYPIFICATION AND NOMENCLATURE: *Arum esculentum* is apparently typified by the illustration of *Arum minus*, *nymphaea folio*, *esculentum* Sloane (Voy. Jam. Nat. Hist. 1: 167. 1707, 2: t. 106, fig. 1. 1725), although actual specimens seen by Linnaeus before 1753 may exist in the Sloane or Clifford Herbaria (BM). Linnaeus

apparently regarded this taxon as an American species. It is probable that it was introduced into the New World after 1492, probably for consumption by African slaves. *Arum colocasia* and its homotypic synonyms, including *Colocasia antiquorum* (of the ancients), can be typified by a single leaf specimen in the Linnean Society of London herbarium, marked with a symbol for "Central Asia," although Linnaeus published the habitat as "Cretae, Cypri, Syriae, Aegypti aquis." There is some question of the place of first valid publication of *Colocasia antiquorum* var. *esculenta*. It is commonly attributed to Schott (Syn. Aroid. 42. 1856, or Prodr. Syst. Aroid. 140. 1860), but I do not believe that the (1) listing of *Colocasia esculenta* as a synonym of *C. antiquorum* and (2) a statement that "*C. esculenta* = *C. antiq.* S. var." constitute definite indication that the "epithets concerned are to be used in that particular combination," as required by Art. 33, ICBN. A parallel example "of combinations not definitely indicated" is given (Art. 33), "The combination *Eulophus peucedanoides* must not be ascribed to Bentham on the basis of the listing of *Cnidium peucedanoides* H.B.K. under *Eulophus*." Apparently Seemann was the first actually to make the combination.

DISTRIBUTION: Widely cultivated throughout the tropics; in Fiji it is abundantly cultivated on wet or dry ground at elevations from near sea level to 800 m. It is infrequently collected, doubtless because of the distaste of collectors for preparing specimens of common cultivated plants; even *Seemann 655b*, cited by him, is no longer to be found at BM or K.

LOCAL NAMES AND USES: While *ndalo* is the usual Fijian name, the following have also been recorded: *Mba*; *mboka*; *mbotiki*; *ndoko*; *nggau*; *sol*; *suli*; *sulo*; and *votuki* (J. W. Parham, 1964, 1972). Seemann (1868) gives many other local names, along with an amusing, if somewhat gruesome, anecdote. More than 80 local cultivar names are reported from Fiji. The tubers provide a staple food, acrid when fresh but edible after cooking in various ways; the young leaves are also cooked and used as a vegetable. Portères (in J. Agr. Trop. Bot. Appl. 7: 169-192. 1962) reports that most of the vernacular names applied to this food plant indicate the deep or dark color of the plant; for example, *taro* (*talo*) is derived from a Sundanese radical meaning deep blue. *Dasheen*, however, is a corruption of "de Chine" (of China).

AVAILABLE COLLECTIONS: VITI LEVU: NAITASIRI: Nanduruloulou, *Barrau 573*. TAILEVU: Wainimbokasi, *DA 815*. FIJI without detailed locality, foliage parts collected by C. R. Cooper as vouchers for various locally named cultivars, *DA 9292-9317 incl.*

11. *CALADIUM* Vent. Descr. Pl. Nouv. Jard. Cels, 30. (Mar. 1) 1801, in Roemer, Arch. Bot. 2: 347. (Mar.-Dec.) 1801; Engl. in Pflanzenz. 71 (IV. 23E): 23. 1920.

Herbs with a tuberous rhizome; leaves often peltate, the secondary veins irregularly forming a collective vein between the primary lateral veins; peduncle solitary; lower spathe persistent, green, the upper spathe white and withering; spadix pistillate at base, staminate above with a transition zone of sterile flowers; staminate flowers of 3-5 stamens united in truncate syndandria; pistillate flowers with sessile stigma, incompletely 2- or 3-locular, the ovules anatropous, many, biseriate on deeply intrusive parietal placentae, these united (axillary) at top and bottom; berry whitish, polyspermous; seeds more or less ovoid, very shortly funiculate, with many longitudinal grooves (sulci).

LECTOTYPE SPECIES: *Caladium bicolor* (Ait.) Vent. (*Arum bicolor* Ait.); vide Hubbard & Rehder in Mus. Bot. Leaflet. 1: 3. 1932.

DISTRIBUTION: About 20 neotropical species, at least one widely cultivated as an ornamental; this is the only species reported from Fiji.

1. *Caladium bicolor* (Ait.) Vent. Descr. Pl. Nouv. Jard. Cels, 30. t. (Mar. 1) 1801, in Roemer, Arch. Bot. 2: 348. (Mar.-Dec.) 1801; Engl. in Pflanzenr. 71 (IV. 23E); 31. 1920; Yuncker in Bishop Mus. Bull. 178: 31. 1943; J. W. Parham, Pl. Fiji Isl. 266. 1964, ed. 2. 361. 1972.

Arum bicolor Ait. Hort. Kew. 3: 316. 1789.

Caladium × *hortulanum* Birdsey, Cult. Aroids, 42. 1951.

Rhizome globose; petiole pruinose; leaf blade peltate, above with various colors and variegations, beneath glaucous; peduncle a little shorter than petiole; spathe blade twice as long as lower spathe; spadix with sterile portion equalling the pistillate, the staminate portion twice as long as pistillate.

TYPIFICATION AND NOMENCLATURE: The type of *Arum bicolor* Ait. is probably to be found in the Banksian Herbarium (BM). *Caladium hortulanum* Birdsey is typified by Birdsey 210 (UC). The latter was proposed for variants in horticulture that were felt not referable to *C. bicolor* (Ait.) Vent. Birdsey does not state how the two species are differentiated. I believe the older name, based on a cultivated plant, is applicable to the many cultivars that have been developed. Most of the varieties named by Engler (1920, cited above) appear to be cultivars.

DISTRIBUTION: The origin of Aiton's cultivated plant was South America, but the species is now widely distributed in cultivation. No Fijian specimens are available, but it is reported by Parham (1964, 1972, cited above) as having been introduced in the 1880's.

USE: In Fiji, as elsewhere, the species is used as an ornamental for its striking leaves variously marked with shades of green, white, and red.

12. *XANTHOSOMA* Schott in Schott & Endl. Melet. Bot. 19. 1832; Engl. in Pflanzenr. 71 (IV. 23E); 41. 1920.

Herbs with erect or tuberous rhizomes; leaf sagittate to pedatisect, the midvein of the posterior lobes often denuded, the secondary veins confluent and forming a zigzag collective vein between and parallel to the primary lateral veins; lower spathe persistent, the upper spathe withering; spadix pistillate below, staminate above, with sterile flowers between; staminate flowers of 4-6 stamens united in synandria; pistillate flowers with broad and coherent styles, the ovaries 2-4-locular with many subanatropous ovules borne near center of the axillary placenta; berry polyspermous; seed ovoid, sulcate.

LECTOTYPE SPECIES: *Xanthosoma sagittifolium* (L.) Schott (*Arum sagittifolium* L.); vide Nicolson in Taxon 24: 345. 1975.

DISTRIBUTION: A neotropical genus with fewer than 40 species, widely cultivated for food and ornament.

Xanthosoma is a difficult genus, much in need of reconsideration of species definitions. Traditionally (Engl., 1920, cited above) the taxa are divided by whether they form an aerial stem (*X. sagittifolium*, *X. undipes*, the latter commonly called *X. jacquinii*) or only a subterranean tuberous caudex (*X. nigrum*, often called *X. violaceum*, *X. atrovirens*, *X. mafaffa*, *X. caracu*, and *X. belophyllum*). Within each group there is subdivision on whether or not the midribs of the posterior lobes are denuded next to the petiolar attachment. I have grave doubts whether or not these characters define biological species with their usual ranges of variability, suspecting that they are leftovers from a time when species had to be understood and defined in terms of one or a few herbarium specimens. Study of variability in wild populations is badly needed to give a perspective for understanding the variability in cultivation. Those

interested in cultivated taxa should consult Morton (in Proc. Florida State Hort. Soc. **85**: 85–94, 1972) for the discussion and bibliography.

KEY TO SPECIES

- Posterior midribs covered by leaf blade all the way to the petiole attachment; petiolar sheath with a smooth margin. 1. *X. sagittifolium*
 Posterior midribs denuded for several centimeters from the petiole attachment; petiolar sheath with undulate margins. 2. *X. undipes*

1. ***Xanthosoma sagittifolium* (L.) Schott** in Schott & Endl. Melet. Bot. 19, as *X. sagittaeifolium*. 1832; Engl. & Krause in Pflanzenr. **71** (IV. 23E): 45, fig. 9, A. 1920; B. E. V. Parham in Agr. J. Dept. Agr. Fiji **13**: 41, 1942; Barrau in Bishop Mus. Bull. **219**: 42, 1958, in op. cit. **223**: 39, 1961; J. W. Parham, Pl. Fiji Isl. 267, 1964, ed. 2. 363, 1972; Nicolson in Taxon **24**: 347, 1975.

Arum sagittifolium L. Sp. Pl. 966, as *A. sagittaeifolium*, 1753; Jacq. Hort. Vindob. **2**: 73, t. 157, 1772.

Arum xanthorrhizon Jacq. Pl. Rar. Hort. Schoenbr. **2**: 32, t. 188, 1797.

Xanthosoma atrovirens Koch, 1854 Ind. Sem. Hort. Berol. App. 3, nom. illeg. 1855.

Erect stem in mature specimens 1 m. or more high; leaves broadly sagittate-ovate, the anterior lobe twice as large as the posterior lobes, the posterior midribs not denuded next to the petiolar attachment; lower spathe 6–7 cm. long, the upper spathe greenish white, about 15 cm. long; pistillate and sterile parts of the spadix 3–4 cm. long each, the staminate portion 5–6 cm. long.

TYPEFIICATION AND NOMENCLATURE: The type of *Arum sagittaeifolium* L. seems to be *Arum minus esculentum, sagittariae foliis viridis nigricantibus* (the smallest edible arum with leaves of *Sagittaria* green, becoming black) Sloane (Voy. Jam. Nat. Hist. **1**: 167, 1707, **2**: t. 106, fig. 2, 1725), although there may be a specimen seen by Linnaeus in the Sloane or Clifford Herbaria (BM). Adams (Fl. Pl. Jam. 68, 1792) regards the species as introduced, cultivated and naturalizing in Jamaica, not as native. The same Sloane plate is cited as the basis for *Xanthosoma atrovirens* Koch; hence that binomial is an illegitimate (superfluous) renaming. Without revisionary studies, it is not known to what taxon Koch apparently misapplied his name, characterized as acaulescent. Morton (in Proc. Florida State Hort. Soc. **85**: 85, 1972) suggested abandonment of the binomial *X. sagittifolium* because it has been loosely applied, but this is not possible under the present ICBN.

DISTRIBUTION: Neotropical but, pending revisionary work, exact native distribution uncertain. In Fiji it is commonly cultivated, mostly by Indians, but it is also naturalized along stream banks.

LOCAL NAMES AND USE: The usual Fijian name is *ndalo ni tana*, but *ndalo ni kana* and *ghuya* have also been recorded. The tubers, although edible, are considered inferior to those of *Colocasia* but are used locally as a subsistence crop.

AVAILABLE COLLECTIONS: VITI LEVU: NAITASIRI: Adi Cakobau School, Sawani, DA 3413. TAILEVU: Nambua, DA 10127.

2. ***Xanthosoma undipes* (Koch) Koch** in Bonplandia **4**: 4, 1856; Nicolson in Taxon **24**: 347, 1975.

Xanthosoma jacquinii Schott (in Schott & Endl. Melet. Bot. 19, nom. nud. 1832), Syn. Aroid. 56, 1856;

Engl. in Pflanzenr. **71** (IV. 23E): 47, fig. 9, D, E. 1920; non Schott ex Kunth (Enum. Pl. **3**: 44, 1841).

Alocasia undipes Koch, 1854 Ind. Sem. Hort. Berol. App. 4, 1855.

Caudex to 1 m. long and 20 cm. thick; petiole with an undulate sheath; leaf blade with posterior midribs denuded for 1–several cm.; lower spathe to 7 cm. long, atropurpureous inside, the upper spathe 15–25 cm. long, yellowish green outside, whit-

ish inside; pistillate part of spadix about 2.5 cm. long, the sterile part 7–8 cm. long, the staminate part 6–7 cm. long.

TIPIFICATION AND NOMENCLATURE: According to Stafleu (Tax. Lit. 241. 1967), Koch's types are extant, although the set at B does not contain all of Koch's original specimens. As discussed by me (in Taxon 24: 346. 1975), the binomial *Xanthosoma jacquinii* (1832) can be regarded as a validly published but superfluous renaming of "*Arum xanthorrhizon* Jacq." However, Schott (Syn. Aroid. 57. 1856) states under *X. jacquinii*: "*Arum xanthorrh.* Horti Schoenbr. ex Jacq.—sed non *A. xanthorrh.* Jacq. Hrt. Schoenbr. II, t. 188." Thus, Schott, Engler, and I have regarded Schott's 1832 synonymy "*Arum xanthorrhizon* Jacq." not as a reference to Jacquin's published name, but to a different species cultivated in the garden and misidentified by Jacquin as *A. xanthorrhizon*. Whether or not this admittedly controversial conclusion is accepted, the effect is the same: *X. jacquinii* is not an available name, and the oldest available name for the taxon hitherto passing under that name is *X. undipes*.

DISTRIBUTION: According to Engler, this taxon is found in Florida, Mexico, the West Indies, Venezuela, and Ecuador. Of the two known collections in Fiji, one is sterile and was cultivated at about 150 m.; the second was apparently naturalized on the edge of forest at 300 m., being in late flower in April.

USES: The sterile specimen is said to provide an excellent vegetable, the leaves being cooked like spinach. Of the naturalized specimen the collector notes: "large edible rhizome." Presumably the species at one time was more widely utilized in Fiji.

AVAILABLE COLLECTIONS: VITI LEVU: NAITASIRI: Toninaiwau, Tholo-i-suva, DA 16751. OVALAU: Slopes of Mt. Koronimoko, vicinity of Thawathi, Smith 8089.

FAMILY 41. LEMNACEAE

LEMNACEAE S. F. Gray, Nat. Arr. Brit. Pl. 2: 729, as *Lemnadeae*. 1821.

Monoecious (very rarely dioecious) aquatic annuals, small to minute, floating on or just below surface of freshwater, or completely submerged and rising to surface in flowering period; each plant composed of a small, discoid, leafless, thalloid frond; fronds solitary or connected in small groups by short stipes, symmetric or asymmetric, flat or inflated, reniform or linear to globose, green, sometimes with red or brown pigment cells; roots several, 1, or none; budding pouches 1 or 2 (if 1, a flowering cavity bearing a spatheless inflorescence) (if 2, 1 giving rise to an inflorescence surrounded by a spathe); inflorescence consisting of 1 ♀ and 1 or 2 ♂ flowers; perianth none; ♂ flower with a single stamen, the anther 1- or 2-locular; ♀ flower inserted above the ♂, consisting of a sessile, globose, 1-locular ovary, the ovules 1–4, basal, erect, orthotropous to anatropous, the style short; fruit a 1–4-seeded utricle, the seeds ribbed or smooth, the endosperm sparse.

DISTRIBUTION: Essentially cosmopolitan but primarily tropical and warm temperate; six genera and about 29–35 species.

USEFUL TREATMENTS OF FAMILY: Daubs, E. H. A Monograph of Lemnaceae. 118 pp., Univ. Illinois Press. 1965. Hartog, C. den, & F. van der Plas. A synopsis of the Lemnaceae. Blumea 18: 355–368. 1970.

Of the six genera recognized by den Hartog and van der Plas, the two occurring in Fiji, *Lemna* and *Spirodela*, comprise the subfamily Lemnoideae, which is characterized by the presence of roots, by having two budding pouches, by the presence of a membranous spathe enclosing the inflorescence, by having a bilocular anther, and by the presence of raphides. The second subfamily, the Wolffioideae, lacks

roots, has a single budding pouch, lacks a spathe, has a unilocular anther, and lacks raphides.

The species of Lemnaceae often have wide and haphazard distributions; the small plants are probably vegetatively transported on the feet of waterbirds, flowering being infrequent.

KEY TO GENERA

- Fronds without dorsal and ventral scales, with 1 root (or rarely none) and with 1-3 often indistinct nerves, interconnected by marginally attached stipes, without brown pigment cells and druses; our species with obliquely ovate-elliptic fronds $2.5 \times 2-4$ mm. or smaller, green, 3-nerved. 1. *Lemna*
 Fronds with a dorsal and a ventral scale, with 1-many roots and with 3-15 nerves, interconnected by ventrally attached stipes, with brown pigment cells and druses in parenchyma; our species with narrowly obovate to ovate-oblong fronds $4-8 \times 1.5-4$ mm., purplish beneath, 3-5-nerved, with 2-5 long roots. 2. *Spirodela*

1. *LEMNA* L. Sp. Pl. 970. 1753; Hegelmaier, Die Lemnaceen, 134. 1868; Seem. Fl. Vit. 288, p. p. 1868; Daubs, Monogr. Lemnac. 16. 1965; den Hartog & van der Plas in *Blumea* 18: 360. 1970.

Small water plants floating on surface or sometimes completely submerged and coming to surface only in flowering period; fronds solitary or connected in groups of 2-10 (or more), symmetric or slightly asymmetric, round or elliptic to obovate or lanceolate, flat or slightly swollen, sometimes inflated; brown pigment cells none; stomata dorsal on floating plants but absent in submerged plants; margins entire, rarely denticulate, the nerves 1-3 (-5); stipe hyaline and fugacious or green and persistent; dorsal and ventral scales absent; root 1 (rarely absent); slit of budding pouch coinciding with margin of frond, rarely ventral or dorsal to margin; ovary with 1 orthotropous or amphitropous ovule or 2-4 anatropous ovules; fruit symmetric or asymmetric.

LECTOTYPE SPECIES: Both *Lemna trisulca* L. and *L. minor* L. have been indicated as the type species; den Hartog and van der Plas (1970, p. 361) consider the latter the better choice.

DISTRIBUTION: A nearly cosmopolitan genus with about nine species. One widespread species occurs in Fiji.

1. *Lemna perpusilla* Torrey, Fl. State New York 2: 245. 1843; Daubs, Monogr. Lemnac. 25. pl. 9. 1965; den Hartog & van der Plas in *Blumea* 18: 363. 1970.

FIGURE 91.

Lemna minor sensu Seem. in *Bonplandia* 9: 260. 1861, Viti, 444. 1862; Kurz in *J. Bot.* 5: 115. 1867; Seem. Fl. Vit. 288. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 327. 1892; Yuncker in *Bishop Mus. Bull.* 220: 76. 1959; J. W. Parham in *Dept. Agr. Fiji Bull.* 35: 147. 1959, Pl. Fiji Isl. 268. 1964, ed. 2. 363. 1972; non L.

Lemna paucicostata Hegelmaier, Die Lemnaceen, 139. t. 8. 1868; Seem. Fl. Vit. 434. 1873; Christoffersen in *Bishop Mus. Bull.* 128: 44. 1935; J. W. Parham, Pl. Fiji Isl. ed. 2. 364. 1972; B. E. V. Parham in *New Zealand Dept. Sci. Indust. Res. Inform. Ser.* 85: 29. 1972.

The only species of *Lemna* known to occur in Fiji may be sought from near sea level to about 450 m.; it occurs floating in stagnant pools in forests, in slowly moving water of the sloughs of rivers, and on vertical, dripping rocks near waterfalls.

TIPIFICATION AND NOMENCLATURE: The holotype (NY) was presumably collected by Torrey on Staten Island, New York, U.S.A.; Daubs mentions that an isotype is at MO. In describing *Lemna paucicostata*, Hegelmaier listed many specimens from Asia, Africa, and America, and I have not noted a lectotypification. The two recent treatments of the family agree in combining these taxa.

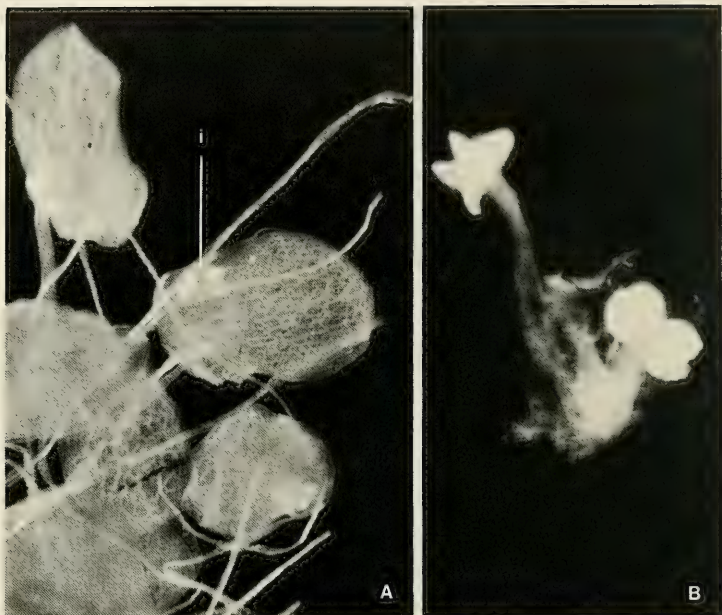


FIGURE 91. *Lemna perpusilla*, from *St. John 18373*; A, a few fronds, some with budding pouches containing young inflorescences (i), $\times 20$; B, an inflorescence, showing an ovary, 2 bilocular stamens, and the disrupted remnants of the membranous spathe, $\times 70$.

DISTRIBUTION: Tropical and temperate regions of both hemispheres; in the Pacific collections have been seen from New Caledonia, Tonga, and Samoa as well as Fiji, but it is infrequently collected.

LOCAL NAME AND USE: *Kala*; the entire plants may be eaten as greens.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: About 16 km. inland from Tavua along road to Nandarivatu, O. & I. Degener 32000. NAITASIRI: Sawanikula, Wainimala Valley, *St. John 18373*. TAILEVU: Mburetu/Ndaku, DA 884. VITI LEVU without further locality, *Seemann 657*. OVALAU: Baron A. v. Hügel, May or June, 1875, 103 + 106 (from collection sheet 7114 + 7117) (κ).

2. SPIRODELA Schleiden in *Linnaea* 13: 391. 1839; Daubs, Monogr. Lemnac. 8. 1965; den Hartog & van der Plas in *Blumea* 18: 358. 1970.

Small water plants floating on surface; fronds solitary or connected in groups of 2-5 (or more), symmetric or asymmetric, reniform to obovate, flat or inflated, often reddish beneath due to pigment cells in epidermis; brown pigment cells, raphides, and druses present in parenchyma; stomata dorsal; margin entire, the nerves 3-15; stipe hyaline, attached to lower surface of frond; dorsal scale present, at length fugacious; ventral scale broad, sometimes pigmented; roots 1-18, clustered together and covered by ventral scale, 1 or more roots perforating this scale; slit of budding

pouch ventral to margin of frond; ovary with 1 amphitropous ovule or 2-4 anatropous ovules; fruit asymmetric.

TYPE SPECIES: *Spirodela polyrhiza* (L.) Schleiden (*Lemna polyrhiza* L.).

DISTRIBUTION: About four species in the tropical and temperate zones of both hemispheres. One widespread species has been noted in Fiji.

1. *Spirodela punctata* (G. F. W. Meyer) Thompson in Ann. Rep. Missouri Bot. Gard. 9: 28. 1898; Daubs, Monogr. Lemnac. 15. 1965; den Hartog & van der Plas in Blumea 18: 360. 1970.

Lemna punctata G. F. W. Meyer, Prim. Fl. Esseq. 262. 1818.

Lemna gibba sensu Seem. in Bonplandia 9: 260. 1861, Viti, 444. 1862; non L.

Lemna oligorrhiza Kurz in J. Linn. Soc. Bot. 9: 267. t. 5. 1866; Greenwood in Proc. Linn. Soc. 154: 104. 1943; J. W. Parham in Dept. Agr. Fiji Bull. 35: 147. 1959, Pl. Fiji Isl. 268. 1964, ed. 2. 363. 1972.

Lemna melanorrhiza F. v. Muell. & Kurz in J. Bot. 5: 115. 1867; Seem. Fl. Vit. 288. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 327, 410. 1892.

Spirodela oligorrhiza Hegelmaier, Die Lemnaceen, 147. t. 16. 1868.

Spirodela oligorrhiza var. *melanorrhiza* Hegelmaier, Die Lemnaceen, 148. 1868; Seem. Fl. Vit. 434. 1873.

Spirodela oligorrhiza Hegelmaier ex Daubs, Monogr. Lemnac. 14. pl. 4. 1965.

In Fiji this widespread species may be found near sea level, or perhaps slightly higher, in stagnant water covering ponds and in swampy pools.

TYPIFICATION AND NOMENCLATURE: The type of *Lemna punctata* was collected, presumably by Meyer, along the Essequibo River in British Guiana; it may possibly still be in existence at GOET. *Lemna oligorrhiza* is typified by a collection made by Kurz in a watercourse of the Calcutta Botanic Garden, India. In describing *Lemna melanorrhiza*, Mueller and Kurz listed a collection by F. v. Mueller from West Australia as well as *Seemann 656* from Viti Levu; from the protologue it is evident that their concept was primarily based on Mueller's material, which may be considered the lectotype. Daubs recognizes both *Spirodela punctata* and *S. oligorrhiza*, but I here follow den Hartog and van der Plas in combining them under the older name.

DISTRIBUTION: Throughout the tropics and subtropics of both hemispheres; except for specimens here cited, I have seen no other Pacific material.

LOCAL NAMES: *Kala*; *duckweed*; *pondweed*.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Hills near Lautoka, floating on water in a taro plantation, *Greenwood 153*. NAITASIRI, TAILEVU, or REWA: Lower Rewa River, *Naumann*, Dec. 1, 1875 (not seen). VITI LEVU without further locality, *Seemann 656*.

ORDER PANDANALES

FAMILY 42. PANDANACEAE

PANDANACEAE R. Br. Prodr. Fl. Nov. Holl. 340, as *Pandaneae*. 1810.

Dioecious trees or shrubs, rarely herbs, sometimes scrambling woody vines, the trunks or stems simple or branched, often with aerial roots; leaves 3- or 4-seriate, often spiralled (except in *Sararanga*) and crowded toward apices of stems of branches, linear or lanceolate, coriaceous, sheathing at base, keeled, closely parallel-nerved, acute to acuminate at apex, usually spinulose on margins and keel; inflorescence axillary, lateral below leaves, or terminal, usually a racemose or branched spadix, often congested, the spadices fasciculate, spicate, paniculate, or solitary, at first enclosed by spathaceous, often colored bracts; flowers pedicellate (in *Sararanga*) or sessile (in *Freycinetia* and *Pandanus*), the perianth lacking (small and gamophyllous in *Sararanga*); ♂ flowers with numerous stamens, crowded on rachises or on

branches of spadix, the filaments free or variously connate, the anthers basifixed, 2-locular, the locules sometimes again divided, dehiscing by longitudinal slits, a vestigial ovary present or absent; ♀ flowers with small, hypogynous staminodes or these absent; ovary superior, 1-locular, free or appressed to and sometimes fused with adjacent ovaries, the ovules solitary to many, basal or parietal, anatropous, the style usually short or none, the stigmas 1 or more, variously shaped and arranged; syncarps (cephalia) oblong or cylindric to ellipsoid or globose, with densely crowded mature carpels, these woody, drupaceous or baccate, free or often connate into phalanges, the seeds small, with fleshy endosperm and a minute embryo.

DISTRIBUTION: Tropics and subtropics of the Old World, with three genera and at least 1,000 species. *Sararanga* includes two species in the Philippines, western New Guinea, the Bismarck Archipelago, and the Solomons. *Freycinetia* and *Pandanus*, with many species, are distributed over much of the range of the family.

KEY TO GENERA

- Stems scrambling or climbing, provided with long, pendulous, aerial roots; prop roots lacking; spadices simple, usually 2-5 aggregated, rarely solitary; stamens borne directly on rachis; staminodes present and hypogynous in ♀ flowers; ovary 1-celled, with numerous ovules on 2 or more parietal placentas; fruit a berry. 1. *Freycinetia*
- Stems usually erect, not climbing, simple or branched, often with aerial roots and prop roots; ♂ spadices simple or branched; ♀ flowers lacking staminodes, the ovaries free or connate into clusters (phalanges), 1-several-celled, each cell 1-ovuled, the placentas subbasal; fruit a drupe. 2. *Pandanus*

1. FREYCINETIA Gaud. in Ann. Sci. Nat. 3: 509. 1824, Voy. Uranie et Physicienne, Freycinet, Bot. 431. 1829; Seem. Fl. Vit. 282. 1868; Warb. in Pflanzenr. 3 (IV. 9): 26. 1900; Martelli in Univ. Calif. Publ. Bot. 12: 326. 1930; Perry in J. Arnold Arb. 31: 208. 1950; Stone in Proc. Biol. Soc. Wash. 78: 81. 1965, in Gard. Bull. Singapore 22: 129. 1967, in Blumea 16: 361. 1968.

Scrambling or climbing shrubs, rarely herbs, with adhesive roots and sometimes with long, pendulous, aerial roots; leaves basally with membranous, fragile, marcescent or caducous margins (auricles); flowers in terminal (in all our species) or lateral inflorescences consisting of simple spadices (usually 2-5), these congested into an umbel or short raceme and at first enclosed by several, 3-seriate, fleshy, green or colored spathes, these caducous; stamens densely congested on rachis; ♀ ovaries densely congested on rachis, usually with minute staminodes, 1-celled, the ovules numerous, congested on 2 or more parietal placentas, the stigmas 2 or more, separate or confluent; fruits baccate, the seeds oblong.

LECTOTYPE SPECIES: *Freycinetia arborea* Gaud. (vide Stone in Gard. Bull. Singapore 22: 129. 1967).

DISTRIBUTION: Ceylon and southeastern Asia throughout Malasia, northward to the Ryukyu Islands and Taiwan, southward to northern Australia and New Zealand, and eastward in the Pacific to the Bonin and Caroline Islands, Hawaii, and the Marquesas, with 150-200 species.

LOCAL NAMES AND USES: For the most part Fijians seem to use generic local names for *Freycinetia*, the following being applicable to any species of the genus: *wa me, me, meri, merimeri, mere*, and *merikula*. Additional and perhaps more specific local names have been recorded as follows: *tuvuni* (*F. caudata* in Tailevu Province), *weilimbale* (*F. caudata* in Mba Province), *vakavuka* (*F. urvilleana* and *F. storckii* on Vanua Levu), *walutu* (*F. pritchardii*), and *nembanemba* (*F. vitiensis*); the last two are questionable in that their precise source is not noted. The climbing stems of any species are softened in water and pounded, the fibers then being used

for tying thatch on house roofs. The fruits of some species are said to attract flying foxes, and occasionally the fruits are reported as being palatable to humans.

USEFUL TREATMENTS OF GENUS: Perry, L. M. The genus *Freycinetia* in Fiji. J. Arnold Arb. 31: 208-213. 1950. Stone, B. C. The genus *Freycinetia* (Pandanaceae) in Fiji, Tonga, and Samoa. Proc. Biol. Soc. Wash. 78: 81-92. 1965. Stone, B. C. Materials for a monograph of *Freycinetia* (Pandanaceae) I. Gard. Bull. Singapore 22: 129-152. 1967. Stone, B. C. Materials for a monograph of *Freycinetia* Gaud. IV. Subdivision of the genus, with fifteen new sections. Blumea 16: 361-372. 1968.

Seemann in 1868 recognized four species of *Freycinetia* in Fiji, all described by him as new and endemic. Martelli in 1930 increased the number of Fijian endemic species to eight, including three that he then described. Perry in 1950 and Stone in 1965 recognized ten Fijian species, all endemic. In his more recent work on the genus, however, Stone has examined the species typified by collections from Samoa, Tonga, and the Societies, suggesting by herbarium annotations that some of the Fijian endemics should be combined with them. This does indeed seem to be the case; I here reduce the number of species in Fiji to eight, of which only three remain endemic.

In reviewing *Freycinetia* as a whole in 1968, Stone proposed its division into 17 sections, describing 15 of them as new. Fruiting specimens are much more frequently observed and collected than flowering specimens, and therefore the syncarps provide the most useful characters, in respect to their shape, size, berry features, and presence or absence of short setae on the syncarp-bearing peduncles. Leaf size and shape are often definitive, as are the membranous, scariose auricles that border the proximal margins of leaves (cf. Stone, 1968, cited above, fig. 18-23); however, the auricles are too fragile and caducous to be often observed in herbarium specimens. The Fijian species fall into only two sections, sect. *Pseudopetiolasae* Stone (typified by the Fijian *F. caudata*) and sect. *Gaudichaudiella* Stone (typified by *F. impavida*, which also occurs in Fiji).

Freycinetia is abundantly represented in Fiji, occurring most frequently in upland forest and on exposed, windswept summits and high ridges. Under these circumstances its means of spread would appear to be wind-carriage or possibly dispersal of the berries by birds. The situation is quite different than in the related genus *Pandanus*, which seldom grows on high crests and which also has heavier drupes or phalanges. The dispersal of the taxa of sect. *Pandanus*, typically found on beaches, is still another matter, for in that section the phalanges are readily transported by seawater and the taxa are consequently highly vagile.

KEY TO SPECIES

- Leaves pseudopetiolate, the blades narrowed and obviously plicate toward base and there petioliform, oblong-lanceolate or oblanceolate, usually 10-33 cm. long, (0.8-) 2-4 (-5) cm. broad, usually abruptly caudate-acuminate at apex, the auricles 1-5 cm. long and 3-5 mm. broad, adnate and decurrent distally; inflorescence terminal, the spadices 3 on a short, common peduncle, each individually pedunculate, the peduncle of the syncarp smooth, not setose or scabrid; syncarps narrowly cylindric, 3-6 × 0.8-1.2 cm., the mature berries obelovate, usually 3-5 × 1.5-2.5 mm., truncate, the stigmas 2-10, the seeds with a broad raphe half their breadth (sect. *Pseudopetiolasae*). 1. *F. caudata*
- Leaves not pseudopetiolate, the auricles 0.5-10 cm. long and 2-10 mm. broad, attenuate or rounded distally; syncarps broad-cylindric to oblong-ellipsoid or subglobose, the mature berries rostrate, the stigmas 2-11 (-13), the seeds with a narrow raphe (sect. *Gaudichaudiella*).
- Syncarps at maturity broad-cylindric, 3-12 cm. long, 1.5-4.5 cm. broad; leaves 30-87 cm. long, (1-) 1.5-6 cm. broad, with auricles 2-10 cm. long and 4-10 mm. broad.
- Peduncles of mature syncarps smooth, not setulose or scabrid, but rarely with a few minute spicules at extreme apex; syncarps 5-12 cm. long; berries linear-oblong to narrowly prismatic or pyramidal, 7-11 mm. long, 2-3 mm. broad, the pileus with nearly parallel or imperceptibly tapered sides, the stigmas 4-10. 2. *F. urvilleana*

- Peduncles of mature syncarps setulose or scabrid or spiculate most noticeably on angles or on all distal surfaces; syncarps 3.5–12 cm. long; berries prismatic or pyramidal, 10–28 mm. long, 3–4 mm. broad, the pileus elongate-pyramidal, tapering, comparatively long and slender, the stigmas 3–10. Leaves 50–87 cm. long, 3–5 cm. broad; peduncles of mature syncarps densely scabrid or setulose or spiculate on angles and especially distally; syncarps 4–12 cm. long, 2.5–4.5 cm. broad; pileus of mature berry elongate, 3–4 mm. long. 3. *F. impavida*
- Leaves 40–70 cm. long, 1–3 cm. broad; peduncles of mature syncarps sparsely scabrid or setulose on angles; syncarps 3–6 cm. long, 1.5–3 cm. broad; pileus of mature berry shorter, 1.5–2.5 mm. long. 4. *F. storckii*
- Syncarps at maturity oblong-ellipsoid or subglobose, 1–4 cm. long, 0.7–3 cm. broad; leaves 7–45 cm. long, 0.3–2 cm. broad, with auricles (as far as known) 0.5–6 cm. long and 2–10 mm. broad.
- Peduncles of mature syncarps smooth, not setulose or scabrid; syncarps oblong-ellipsoid, 3.2–4 cm. long, 1.6–2 cm. broad; leaves 20–30 cm. long, 1–1.6 cm. broad, attenuate-acuminate at apex, not caudate; berries pentagonal-obovoid, 5–8 mm. long and 1.5–2.5 mm. broad, the stigmas 4 or 5 (–8). 5. *F. pritchardii*
- Peduncles of mature syncarps setulose or scabrid or spiculate, at least on angles and usually obviously so distally; syncarps subglobose or short-ellipsoid, 1–3 cm. long, 0.7–3 cm. broad.
- Leaves comparatively short, 7–15 cm. long; mature syncarps 1–2.5 cm. long, 0.7–1.8 cm. broad; berries comparatively few per syncarp.
- Berries ovate-acuminate, about 4–6 × 2–3 mm., truncate at apex; syncarps 1–1.5 × 0.7–1.5 cm., the peduncles densely setulose-scabrid throughout and especially distally; leaves narrowly lanceolate, 0.3–0.8 cm. broad, long-attenuate, subacuminate. 6. *F. vitiensis*
- Berries lageniform, 6–7 mm. long, surmounted by a pale, annular ring; syncarps 2–2.5 × 1.5–1.8 cm., the peduncles sparsely appressed-setulose-scabrid mostly on angles; leaves lanceolate, 1–1.9 cm. broad, gradually attenuate-acuminate. 7. *F. grayana*
- Leaves (16–) 20–45 cm. long, (0.3–) 0.6–2 cm. broad, sometimes caudate-acuminate at apex; peduncles spinulose-setulose (often minutely and sparsely so) along angles; mature syncarps 1.2–3 cm. long and broad; berries numerous and crowded on syncarp, 3–9.5 × 2–3 (–4) mm., attenuate-rostrate, truncate at apex. 8. *F. hombronii*

1. *Freycinetia caudata* Hemsl. in Kew Bull. 1896: 167. 1896; Warb. in Pflanzenr. 3 (IV. 9): 38. 1900; Martelli in Webbia 3: 310. 1910, in Univ. Calif. Publ. Bot. 12: 327. 1930; Perry in J. Arnold Arb. 31: 209. 1950; J. W. Parham, Pl. Fiji Isl. 280. 1964, ed. 2. 375. 1972; Stone in Proc. Biol. Soc. Wash. 78: 82. 1965, in Blumea 16: 366. 1968. FIGURE 92.

An often locally abundant and high-climbing liana, occurring at elevations of 50–1,200 m. in various types of forest and on exposed ridges; the inflorescence-subtending bracts are pale yellow, and the flowering spadices are green or white. Flowers and fruits are to be seen throughout the year.

LECTOTYPIFICATION: Hemsley originally cited *Horne 592* and *Graeffe s. n.*, both from Fiji but without detailed locality. No lectotype has been indicated, but Stone in 1965 cited the Horne collection as the type. This is a good choice, and the lectotype is herewith indicated as *Horne 592* (K), collected in April, 1878, in Fiji without further data.

DISTRIBUTION: Endemic to Fiji, and known from Viti Levu, Kandavu, Ovalau, Vanua Levu, and Taveuni; I have examined 50 collections of this very sharply marked species.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Nandarivatu, *Degener & Ordenez 13679*; Mt. Nanggaranambuluta, *Gillespie 3685*; slopes of Mt. Tomanivi, *DA 12683* (*Melville et al. 7061A & B*). NANDRONGA & NAVOSA: Northern portion of Rairaimatuku Plateau, *Smith 5601*; ridge near Korolevalava, *DA 1439*. SERUA: Track to Mt. Tikituru, *DA 14477*; hills west of Waivunu Creek, between Ngaloa and Korovou, *Smith 9293*. NAMOSI: Near summit of Mt. Naitarandamu, *Gillespie 3362*. NAITASIRI: Between Mt. Tomanivi and Nasonggo, *Smith 5778*; Prince's Road, Nasinu River, *Vaughan 3284*. TAILEVU: Near Wailotua Cave, *DA 9419*. REWA: Mt. Korombamba, *H. B. R. Parham 14*. KANDAVU: Mt. Mbuke Levu, *DA 14937*. OVALAU: U.S. Expl. Exped.; hills east of Lovoni Valley, *Smith 7684*. VANUA LEVU: MBUA: Southern portion of Seatovo Range, *Smith 1548*. MATHUATA–THAKAUNDROVE boundary: Crest of Korotini Range, between Navitho Pass and Mt. Ndelaikoro, *Smith 559*. THAKAUNDROVE: Eastern slope



FIGURE 92. *Freycinetia caudata*, from DA 14937; A, distal portion of a fruiting branch, $\times 1/3$; B, synocarps on smooth peduncles, $\times 2$.

of Mt. Ndikeya, *Smith* 1910. TAVEUNI: Near lake east of Somosomo, DA 17112. FIJI without further locality, *Graeffe s. n.*

There is a considerable amount of variation in the breadth of the leaves of this species. The specimens cited above, like the lectotype, have the leaf blades seldom less than 20 mm. broad and often to 40 (-50) mm. Other specimens have much narrower leaf blades, only 8-15 mm. broad, and some of them have been annotated by Martelli with an apparently unpublished varietal name. However, the narrow-leaved specimens seem to have no geographical or ecological coherence, and I believe that they do not merit recognition at any level. The following specimens represent this concept:

VITI LEVU: MBA: Vicinity of Nandarivatu, *Gillespie* 3167, 3882; Mt. Tomanivi, DA 13019. NAMOSI: Mt. Naitarandamu, *Gillespie* 3104; near Nanggarawai Village, *Gillespie* 3211; Mt. Vakarongasiu, *Gillespie* 3277. NAITASIRI: Near Tamavua Village, *Gillespie* 2107. VANUA LEVU: MBUA: Mt. Seatura, DA 15169. TAVEUNI: Near lake east of Somosomo, DA 14391; western slope between Somosomo and Wairiki, *Smith* 741.

2. *Freycinetia urvilleana* Hombron & Jacquinot in Dumont d'Urville, Voy. Pôle Sud et dans l'Océanie Astrolabe et Zélée, Atlas Bot. Monocot. Phan. pl. 2. 1843; Dec.

Voy. Astrolabe et Zélée, Bot. 2: 83. 1853; Solms-Laub. in Linnaea 42: 106. 1878; Warb. in Pflanzenr. 3 (IV. 9): 38. 1900; Martelli in Webbia 3: 315. 1910, in Univ. Calif. Publ. Bot. 12: 354. 1930; Yuncker in Bishop Mus. Bull. 220: 48. 1959; Stone in Proc. Biol. Soc. Wash. 78: 91. 1965, in Blumea 16: 369. 1968.

FIGURE 93A.

Freycinetia milnei Seem. in Bonplandia 9: 260, nom. nud. 1861, Viti, 444, nom. nud. 1862, ex Kurz in J. Bot. 5: 135, nom. nud. 1867, Fl. Vit. 383. t. 86. 1868; Solms-Laub. in Linnaea 42: 102. 1878; Drake, Ill. Fl. Ins. Mar. Pac. 324. 1892; Warb. in Pflanzenr. 3 (IV. 9): 41. 1900; Gibbs in J. Linn. Soc. Bot. 39: 179. 1909; Martelli in Webbia 3: 313. 1910, in Univ. Calif. Publ. Bot. 12: 330. 1930; Perry in J. Arnold Arb. 31: 210. 1950; J. W. Parham, Pl. Fiji Isl. 281. fig. 99. 1964, ed. 2. 376. 1972; Stone in Proc. Biol. Soc. Wash. 78: 88. 1965.

A high-climbing or sprawling liana, often forming dense tangles in forest and on high ridges, at elevations from near sea level to 1,241 m. The bracts are pale yellow, and fruiting material may be anticipated throughout the year. This species and the next are perhaps the most vigorous of the Fijian *Freycinetiae*; on the summit ridge of Mt. Uluinalau, Taveuni (FIGURE 10, lower), *F. urvilleana* forms such impenetrable tangles a couple of meters thick that it is impossible for a climber to put his feet on the ground.

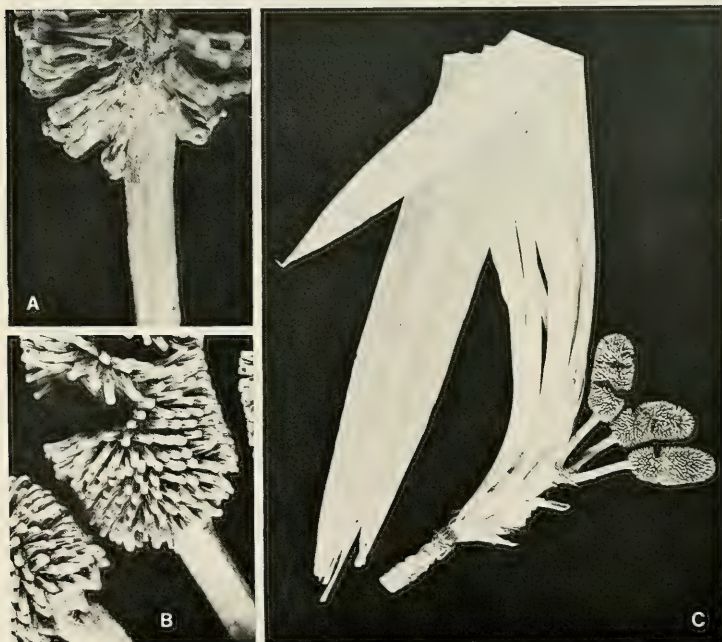


FIGURE 93. A, *Freycinetia urvilleana*, base of a syncarp on a smooth peduncle, with a few proximal berries removed, $\times 2$, from Smith 8239. B, C, *Freycinetia impavida*, from DA 16547; B, bases of syncarps, the peduncles setulose-scabrid distally, $\times 1\frac{1}{3}$; C, distal portion of a fruiting branch, $\times \frac{1}{4}$.

TIPIFICATION AND NOMENCLATURE: The holotype (P) was collected on Vava'u, Tonga, during Dumont d'Urville's expedition of 1837-1840, of which the botanists were Hombron, Jacquinot, and Le Guillou. Stone's citation in 1965 of the original publication requires clarification, as discussed under the following species. In describing *Freycinetia milnei* in 1868, Seemann cited his no. 648 and a collection by Milne, both from Vanua Levu. Of these, the Milne sheet consists of two detached leaves, while the Seemann specimen bears leaves and good syncarps and also a sketch. *Seemann 648* (K) was obviously the primary basis of his description and it is herewith designated the lectotype. Although Tongan material of *F. urvilleana* is not very adequate, the differences between it and *F. milnei* seem inconsequential, as suggested by Stone in 1965.

DISTRIBUTION: Tonga (known only from Vava'u and 'Eua) and Fiji, where it is doubtless more abundant than indicated below.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Vicinity of Nandarivatu, *Gibbs 777*. SERUA: Mbuyombu-yo, near Namboutini, *Tabualewa 15585*; flat coastal strip near Ngaloa, *Smith 9437*. NAMOSI: Hills bordering Wainavindrau Creek, near Wainimakutu, *Smith 8566, 8613*; Wainikoroiluva River, near Namuamua, *Gillespie 3042, Smith 9055*. NAITASIRI: Summit of Mendrausuthu Range, *DA 15478*; northwest of Nasinu, *Gillespie 3496*. NAITASIRI or REWA: "Vicinity of Suva," *Meebold 16417*. KANDAVU: Hills above Namalata and Ngaloa Bays, *Smith 77*. NGAU: Hills east of Herald Bay, inland from Sawaieke, *Smith 7798*. VANUA LEVU: MBUA: Southern portion of Seatovo Range, *Smith 1710*; Nandi, *Milne* in 1855. MATHUATA: Natua, *DA 12862*. THAKAUNDROVE: Savusavu Bay region, *Degener & Ordenez 13819A*. TAVEUNI: Western slope between Somosomo and Wairiki, *Smith 716*; Mt. Manuka, east of Wairiki, *Smith 8239*; summit of Uluinalau, *Smith 895*.

The smooth syncarp peduncles, the large syncarps, and the imperceptibly tapered berries distinguish this species from the following two, which are nearly as robust.

3. Freycinetia impavida (Hombron & Jacquinot) Stone in *Taxon* **17**: 175. 1968, in *Blumea* **16**: 369. 1968, in *Kew Bull.* **31**: 68. 1976. FIGURES 30 (lower), 93B & C.

Victoriperrea impavida Hombron & Jacquinot in Dumont d'Urville, *Voy. Pôles Sud et dans l'Océanie* Astrolabe et Zélée, Atlas Bot. Monocot. Phan. *pl. 1*. 1843; Dec. *Voy. Astrolabe et Zélée*, Bot. **2**: 83. 1853.

Freycinetia victoriperrea Solms-Laub. in *Linnaea* **42**: 103. 1878.

Freycinetia parksii Martelli in *Univ. Calif. Publ. Bot.* **12**: 330. *pl. 39*. 1930; Perry in *J. Arnold Arb.* **31**: 210. 1950; J. W. Parham, *Pl. Fiji Isl.* **281**. 1964, ed. 2. 376. 1972; Stone in *Proc. Biol. Soc. Wash.* **78**: 86. 1965, in *Blumea* **16**: 369. 1968.

Freycinetia marquisensis F. Br. in *Bishop Mus. Bull.* **84**: 28. *fig. 5a*. 1931.

A vigorous liana, high-climbing in dense forest or forming tangles on crest thickets from near sea level to 1,127 m. or higher; mature syncarps are found throughout the year.

TIPIFICATION AND NOMENCLATURE: In proposing the combination *Freycinetia impavida* in 1968, Stone gave convincing reasons for utilizing the epithet *impavida* rather than *demissa*. The type specimen of the former was collected in Tahiti on Dumont d'Urville's expedition with the vessels *Astrolabe* and *Zélée* (1837-1840). The Atlas resulting from the expedition was prepared by Hombron and Jacquinot (1843-1853) and the text for vascular plants by Decaisne (1853) (cf. Stafleu & Cowan, *Tax. Lit.* ed. 2. 697-698. 1976). The portion of the Atlas including *Victoriperrea impavida* and *Freycinetia urvilleana* was published in 1843 (not in 1852 as indicated by Stone). Gaudichaud, who died in 1854, was not a member of the expedition, the plants of which were collected by Hombron, Jacquinot, and Le Guillou. Therefore I believe that it is unnecessary to include Gaudichaud's name in the au-

thorship of the two species in question, the types of which are deposited at P. *Freycinetia parksii* is typified by *Parks 20045* (UC HOLOTYPE; ISOTYPES at BISH, FI, K, SUVA, US), collected in May, 1927, near Lami, west of Suva, alt. 100 m., Rewa Province, Viti Levu, Fiji. Some labels of this number bear the misleading information "in mangrove swamp." Recent annotations by Stone indicate that he now considers the two taxa conspecific, a decision borne out by a substantial series of collections. The holotype of *F. marquisensis* is *F. Brown 459* (BISH), collected July 1, 1921, at Tovii, Nuku Hiva, Marquesas Islands. This and many other Marquesan collections seem precisely to agree with the Society Island material of *F. impavida*.

DISTRIBUTION: Known from the Marquesas and Society Islands, Fiji, and the New Hebrides. Collections from the Cook Islands and Samoa may be anticipated, but currently none seem available. I have examined 40 collections of the species from Fiji, from the islands of Viti Levu, Kandavu, Ovalau, and Vanua Levu.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Eastern slopes of Mt. Koroyanitu, Mt. Evans Range, *Smith 4246*; Mt. Nanggaranambuluta, *Tothill 863*. NAMOSI: Hills north of Wainavindrau Creek, between Korombasambasanga Range and Mt. Naitarandamu, *Smith 8472*. NAITASIRE: Rarandawai, Wainamo-Wainisavulevu divide, Wainimala Valley, *St. John 18273*; Waindrandra Creek, *DA 642*; Sawani-Serea road, *DA 11857*; Tholo-i-suva, *DA 7568*; near Tamavua, *Gillespie 2469*. TAILEVU: Hills east of Wainimbuka River, near Ndakuivuna, *Smith 7051*. REWA: Mt. Korombamba, *DA 16547*. KANDAVU: Mt. Mbuke Levu, *Smith 244*. OVALAU: Mt. Korotolutolu, west of Thawathi, *Smith 8046*; summit of Ndelaiovalau and adjacent ridge, *Smith 7555*. VANUA LEVU: MBUA: Mbua Bay, *U.S. Expl. Exped. MATHUCATA-THAKAUNDROVE* boundary: Crest of Korotini Range, between Navitho Pass and Mt. Ndelaikoro, *Smith 523*. THAKAUNDROVE: Mt. Mariko, *Smith 425*.

4. *Freycinetia storckii* Seem. in *Bonplandia* 9: 260, nom. nud. 1861. Viti, 444, nom. nud. 1862, ex Kurz in *J. Bot.* 5: 135, nom. nud. 1867, Fl. Vit. 283. t. 85. 1868; Solms-Laub. in *Linnaea* 42: 104. 1878; Drake, Ill. Fl. Ins. Mar. Pac. 324. 1892; Warb. in *Pflanzenr.* 3 (IV. 9): 38. 1900; Gibbs in *J. Linn. Soc. Bot.* 39: 179. 1909; Martelli in *Webbia* 3: 315. 1910, in *Univ. Calif. Publ. Bot.* 12: 331. 1930; Perry in *J. Arnold Arb.* 31: 211. 1950; J. W. Parham, Pl. Fiji Isl. 282, fig. 100. 1964, ed. 2. 376, fig. 103. 1972; Stone in *Proc. Biol. Soc. Wash.* 78: 87. 1965, in *Blumea* 16: 369. 1968; St. John & A. C. Sm. in *Pacific Sci.* 25: 345. 1971.

Freycinetia samoensis Warb. in *Bot. Jahrb.* 25: 579, t. 8, fig. A. 1898, in *Pflanzenr.* 3 (IV. 9): 41. 1900; Martelli in *Denkschr. Akad. Wiss. Wien* 85: 230. 1910, in *Occas. Pap. Bishop Mus.* 10 (13): 4. 1934; Stone in *Proc. Biol. Soc. Wash.* 78: 92. 1965, in *Blumea* 16: 369. 1968; B. E. V. Parham in *New Zealand Dept. Sci. Indust. Res. Inform. Ser.* 85: 57. 1972.

Freycinetia gillespiei Martelli in *Univ. Calif. Publ. Bot.* 12: 329, pl. 38. 1930; J. W. Parham, Pl. Fiji Isl. 280. 1964, ed. 2. 375. 1972.

A sometimes locally abundant liana in dense or open forest or in mossy forest at elevations from near sea level to 1,323 m. (or to 1,600 m. in Samoa). The syncarp, found throughout the year, eventually turn dull yellow.

TIPIFICATION AND NOMENCLATURE: The holotype is *Seemann 695* (K), collected May 30, 1860, near the lake east of Somosomo, Taveuni. In describing *Freycinetia samoensis*, Warburg cited *Reinecke 362a*, Oct. 6, 1894, in "Höchste Region," Savaii, Samoa, and *Reinecke 355c*, from (Matafao) Manua, Tutuila, Samoa. Probably both were destroyed at B, and I have located no duplicates. In 1965 Stone cited no. 355c as the type but inadvertently interchanged the localities; I suggest that the Tutuila collection be considered the lectotype. *Freycinetia gillespiei* is based on *Gillespie 2726* (UC probably HOLOTYPE; ISOTYPES at BISH, FI), collected Sept. 6, 1927, on the summit of Mt. Voma, Namosi Province, Viti Levu. Martelli compared his species with *F. milnei*, but in 1950 Perry indicated that she could not separate it from *F. storckii*. Stone's recent annotations indicate that he believes *F. samoensis* also conspecific

with *F. storckii*, a reduction that seems borne out by the available material.

DISTRIBUTION: Samoa (Savaii, Upolu, Tutuila, and Tau), Horne Islands, and Fiji. In the last archipelago it may be more abundant than suggested by the following citations.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Vicinity of Nandarivatu, *Gibbs* 870, *Degener & Ordonez* 14821A; Mt. Nanggaranambuluta, *DA* 10399; summit of Mt. Tomanivi, *Smith* 5155. SERUA: Vicinity of Ngaloa, *Degener* 15129. NAITASIRI: Northwest of Nasinu, *Gillespie* 3497, 3498; Suva Pumping Station, *Degener & Ordonez* 13765. "Southeastern Viti Levu," *Setchell & Parks* 15041. KANDAVU: Mt. Mbuke Levu, *DA* 14943. VANUA LEVU: MATHUATA: Near Lambasa, *Greenwood* 636; southern slopes of Mt. Numbuiloa, *Smith* 6384. THAKAUNDROVE: Mt. Mbatini, *Smith* 689. TAVEUNI: Summit ridge between Somosomo and lake to east, *Gillespie* 4819. MOALA: *Bryan* 342.

This species is not sharply distinct from *Freycinetia impavida*, but it is probably maintainable on the basis of its narrower leaves, smaller syncarps with more sparsely setulose peduncles, and less crowded berries, of which the portion above the seeds is noticeably shorter.

5. *Freycinetia pritchardii* Seem. Fl. Vit. 283. *t.* 84. 1868; Solms-Laub. in *Linnaea* 42: 104, as *F. pritchardii*. 1878; Drake, Ill. Fl. Ins. Mar. Pac. 324. 1892; Warb. in *Pflanzenr.* 3 (IV. 9): 37. 1900; Gibbs in *J. Linn. Soc. Bot.* 39: 179. 1909; Martelli

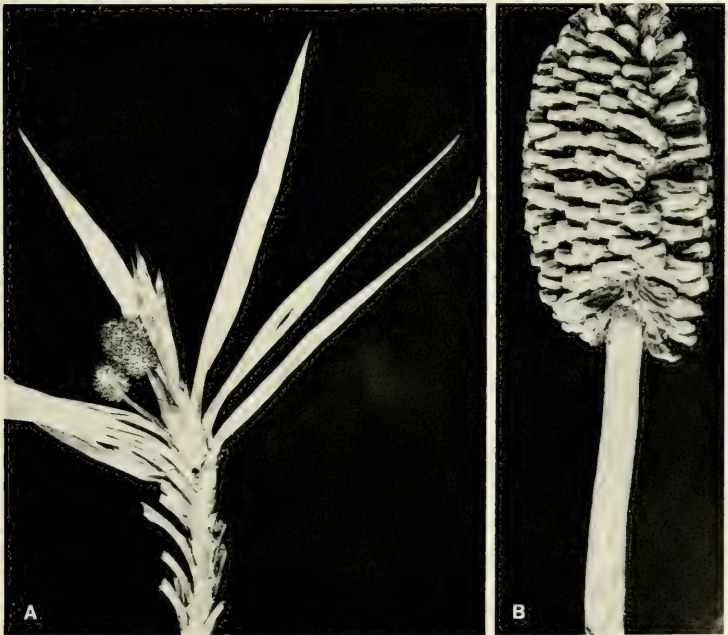


FIGURE 94. *Freycinetia pritchardii*; A, distal portion of a fruiting branch, $\times 1/3$, from *DA* 14557; B, a syncarp on a smooth peduncle, with a few proximal berries removed, $\times 2$, from *Smith* 7698.

in *Webbia* 3: 314. 1910, in *Univ. Calif. Publ. Bot.* 12: 328. 1930; Perry in *J. Arnold Arb.* 31: 211. 1950; J. W. Parham, *Pl. Fiji Isl.* 281. 1964, ed. 2. 376. 1972; Stone in *Proc. Biol. Soc. Wash.* 78: 89. 1965. FIGURE 94.

Freycinetia sp. Seem. in *Bonplandia* 9: 260. 1861, Viti, 444. 1862.

Freycinetia oligodonta Merr. & Perry in *J. Arnold Arb.* 20: 155. 1939.

Like other Fijian species of the genus, this comparatively uncommon taxon is a liana in dense forest or in the dense thickets of crests and ridges. It has been obtained between elevations of about 100 and 1,190 m., flowering between May and July and bearing fruits during months scattered throughout the year.

TIPIFICATION AND NOMENCLATURE: The holotype is *Seemann* 696 (K), collected Aug. 24, 1860, on Mt. Voma, Namosi Province, Viti Levu. In 1965 Stone erroneously cited the Seemann number as 609. The holotype of *Freycinetia oligodonta* is *Brass* 2930 (A), collected at 900 m. in montane rain forest at Hinuahaoro, San Cristoval Island, Solomon Islands. Stone has annotated an isotype at BISH as *F. pritchardii*, and a careful scrutiny discloses no significant differences between the two concepts.

DISTRIBUTION: Fiji (Viti Levu and Ovalau) and the Solomon Islands (San Cristoval). The species may be anticipated from the Santa Cruz Islands and the New Hebrides.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Mt. Koroyanitu, Mt. Evans Range, *DA* 14147; vicinity of Nandarivatu, *Gibbs* 842, *Gillespie* 3747, *Degener & Ordenez* 13680; summit of Mt. Nangaranambuluta, *Gillespie* 3933; hills between Ngaliwana and Nandala Creeks, south of Nauwanga, *Smith* 5667. NAMOSI: Mt. Nambui track, Korombasambasanga Range, *DA* 14557; Mt. Voma, *DA* 570. NAITASIRI: Near Tholo-i-suva, *Parks* 20944; near Tamavua Village, *Gillespie* 2183. REWA: "Lauthala Bay" (a questionable locality for this species), *DA* 7412. OVALAU: *U.S. Expl. Exped.*; summit of Mt. Tana Lailai and adjacent ridge, *Smith* 7698.

The remaining species in the present treatment are distinctly less robust, in their leaves and syncarps, than the species numbered 2, 3, and 4.

6. *Freycinetia vitiensis* Seem. in *Bonplandia* 9: 260, nom. nud. 1861, Viti, 444, nom. nud. 1862, ex Kurz in *J. Bot.* 5: 135, nom. nud. 1867, Fl. Vit. 282. t. 83. 1868; Solms-Laub. in *Linnaea* 42: 105. 1878; Drake, Ill. Fl. Ins. Mar. Pac. 324. 1892; Warb. in *Pflanzenr.* 3 (IV. 9): 35. 1900; Martelli in *Webbia* 3: 315. 1910, in *Univ. Calif. Publ. Bot.* 12: 326. 1930; Perry in *J. Arnold Arb.* 31: 213. 1950; J. W. Parham, *Pl. Fiji Isl.* 282. 1964, ed. 2. 376. 1972; Stone in *Proc. Biol. Soc. Wash.* 78: 84. 1965. FIGURE 95.

An infrequent liana in dense forest, occurring at elevations of about 600 to 900 m. Fruiting material has been obtained between August and January.

TIPIFICATION: The type is *Seemann* 647 (K HOLOTYPE; ISOTYPES at BM, GH), collected Aug. 24, 1860, on Mt. Voma, Namosi Province, Viti Levu. The K sheet is inadvertently numbered 646 (a number correctly assigned to *Typha*), but it is listed as 647 in Seemann's publications and also so numbered on the isotypes.

DISTRIBUTION: A rare species endemic to Fiji and thus far known from only four collections.

AVAILABLE COLLECTIONS: VANUA LEVU: MATHUATA-THAKAUNDROVE boundary: Crest of Korotini Range, between Navitho Pass and Mt. Ndelaikoro, *Smith* 546. TAVEUNE: Borders of lake east of Somo-somo, *Smith* 922, *DA* 17113.

This unmistakable species is characterized by its short and very narrow leaves, which gradually taper to a subacuminate apex, and its small, subglobose syncarps with densely setulose-scrabrid peduncles and small, comparatively few berries.



FIGURE 95. *Freycinetia vitiensis*, from Smith 922; A, fruiting branches, $\times 1/3$; B, a syncarp, showing densely setulose-scabrid peduncles, $\times 2$.

7. *Freycinetia grayana* Perry in J. Arnold Arb. **31**: 212. 1950; J. W. Parham, Pl. Fiji Isl. 280. 1964, ed. 2. 375. 1972; Stone in Proc. Biol. Soc. Wash. **78**: 84. 1965.

A little-known liana, probably occurring not much above sea level, differing from the preceding only in its broader (but still very short) leaves, its somewhat larger syncarps with less obviously setulose-scabrid peduncles, and its slightly larger berries.

TYPIFICATION: The holotype (GH) is a U.S. Exploring Expedition specimen collected in 1840, presumably at Mbua Bay, Mbua Province, Vanua Levu. An isotype (US 65327), however, bears a note reading "Ovelou 3" as well as one indicating Sandalwood Bay (i. e. Mbua Bay).

DISTRIBUTION: Endemic to Fiji and thus far known only from the type collection.

8. *Freycinetia hombronii* Martelli in Denkschr. Akad. Wiss. Wien **85**: 230. 1910, in Occas. Pap. Bishop Mus. **10** (13): 5. 1934; Yunker in Bishop Mus. Bull. **184**: 21. 1945; Stone in Proc. Biol. Soc. Wash. **78**: 92. 1965; B. E. V. Parham in New Zealand Dept. Sci. Indust. Res. Inform. Ser. **85**: 43, as *F. hambronii*. 1972.

FIGURE 96.

Freycinetia graeffei Martelli in Univ. Calif. Publ. Bot. **12**: 326. pl. 37 ("*F. graeffii*" in plate). 1930; Perry in J. Arnold Arb. **31**: 212. 1950; J. W. Parham, Pl. Fiji Isl. 280. 1964, ed. 2. 375. 1972; Stone in Proc. Biol. Soc. Wash. **78**: 85. 1965.

Freycinetia degeneri Merr. & Perry in Sargentia **1**: 4. 1942; Perry in J. Arnold Arb. **31**: 212. 1950; J. W. Parham, Pl. Fiji Isl. 280. 1964, ed. 2. 375. 1972; Stone in Proc. Biol. Soc. Wash. **78**: 86. 1965.

Freycinetia intermedia Merr. & Perry in *Sargentia* 1: 4. 1942; Perry in *J. Arnold Arb.* 31: 211. 1950; J. W. Parham, *Pl. Fiji Isl.* 280. 1964, ed. 2. 375. 1972; Stone in *Proc. Biol. Soc. Wash.* 78: 90. 1965.

A high-climbing liana occurring in dense forest (rarely near beaches) at elevations from near sea level to 1,200 m., with yellowish white bracts. Flowering spadices have been collected in April and August and syncarps throughout the year.

TYPIIFICATION AND NOMENCLATURE: Martelli's original description was based on two specimens from Upolu, *Rechinger 1671*, obtained in June, 1905, from "Urwald ober Utumapu," and *Rechinger 1302*, collected in May, 1905, from "Urwald bei Tiavi." The specimens may be available at w or FI. In 1965 Stone indicated no. 1671 as the type, and it may be considered the lectotype. Martelli also indicated that there is a Hombron collection of the species at P from the *Astrolabe* and *Zélée* expedition, but this seems to have no claim to being the holotype. In describing *Freycinetia graeffei*, Martelli listed nine specimens, his plate being based on *Parks 20083*. *Graeffe 1192*, from Ovalau, is sterile, but another Graeffe specimen cited, from Namosi Province, Viti Levu, no. 243, deposited at HBG, was indicated as the type by Stone in 1965; this is a logical choice as lectotype. The holotype of *F. degeneri* is *Degener 15128* (A), collected in May, 1941, at Vatuvilakia, vicinity of Ngaloa, Serua Province, Viti Levu. In recent annotations Stone indicates that these three taxa are



FIGURE 96. *Freycinetia hombronii*, from *Smith 1763*; A, distal portion of a fruiting branch, $\times 1/3$; B, syncarps, showing angled, spinulose-setulose peduncles, a few proximal berries removed from the syncarp on the left, $\times 2$.

synonymous, and indeed I find no consequential differences among the many available specimens. The holotype of *F. intermedia* is Degener 15054 (A), collected in April, 1941, on Mt. Nggamu (summit elevation only 205 m.), vicinity of Ngaloa, Serua Province, Viti Levu. Although *F. intermedia* was described as having immature syncarps 2×1 cm. with smooth peduncles, actually the syncarps are subglobose and the peduncles are sparsely spiculate on the angles, and it appears quite typical of *F. hombronii*. Martelli has annotated several Samoan specimens as a variety of *F. hombronii*, but they have syncarps about twice as long as broad and are better referred to *F. storckii*.

DISTRIBUTION: Samoa (Savaii, Upolu, and Tau) and Fiji. From the latter archipelago more than 40 collections are available.

REPRESENTATIVE COLLECTIONS: VITI LEVU: MBA: Vicinity of Nandarivatu, Greenwood 626A; Mt. Nanggaranambuluta, Webster & Hildreth 14214; hills east of Nandala Creek, Smith 6238; Mt. Tomanivi, DA 12682 (Melville et al. 7060A & B). NANDRONGA & NAVOSA: Northern portion of Rairaimatuku Plateau, Smith 5543; Nausori Highlands, O. & I. Degener 31994. SERUA: Hills between Wainiggere and Waisee Creeks, between Ngaloa and Wainiyambia, Smith 9557; Vunindilo Beach, DA 3414. NAMOSI: Mt. Naitarandamu, Gillespie 3310; hills near Navua River, Greenwood 1051. NAITASIRI: Near Tholo-i-suva, Setchell & Parks 15119; vicinity of Tamavua, Gillespie 2125. REWA: Mt. Korombamba, Gillespie 2374. OVALAU: Graeffe 1192. VANUA LEVU: MBUA: Southern slopes of Mt. Seatura, Smith 1635. MATHUATA: Mt. Ndelaikoro, DA 12814. THAKAUNDROVE: Mt. Kasi, Yanawai River region, Smith 1763; Mt. Vatunivuaomonde, Savusavu Bay region, Degener & Ordenez 13966. TAVEUNI: Vicinity of Wairiki, Gillespie 4721. FIJI without further locality, Horne 844, 903.

This well-marked species differs from the two preceding in its much longer leaves and its crowded berries.

2. *PANDANUS* L. Herb. Amb. 17. 1754; L. f. Suppl. Pl. 64, 424. 1781; Seem. Fl. Vit. 281. 1868; Warb. in Pflanzenr. 3 (IV. 9): 43. 1900; Martelli in Univ. Calif. Publ. Bot. 12: 332. 1930; Stone in Proc. Biol. Soc. Wash. 80: 47. 1967.

Trees or shrubs, usually erect, the trunk simple or branched or sometimes essentially none; prop roots and aerial roots often present, these often verrucose; leaves crowded toward apices of stems or branches, 3- or 4-seriate and either sinistrorsely or dextrorsely spiralled; flowers in large heads or spadices enclosed in spathes; ♂ spadices racemose or branched, with secondary, pale spathes, the stamens numerous, inserted either directly on rachis or on short, racemiform or umbelliform stemonophores; ♀ spadices 1 or more (then spicate), globose, ellipsoid, or cylindric, the ovaries densely crowded, 1-carpellate or with several to many carpels, each carpel 1-ovulate, the stigmas sessile on a short style or style lacking; syncarp (cephalium) often large, breaking into usually numerous phalanges, the pericarp often copiously fibrous, the exocarp fleshy, the mesocarp sometimes with air cavities, the endocarp usually woody or bony, the locules 1 or more, the seed solitary, erect.

TYPE SPECIES AND NOMENCLATURE: The original author of the generic name *Pandanus* is often considered (by St. John, Stone, and others) to be Stickman. In attributing the name to Linnaeus I follow the more usually accepted procedure, as explained in considerable detail by W. T. Stearn (Ray Society facsimile of Linnaeus's *Species Plantarum*, Introduction, 51-55. 1957).

As St. John (in Pacific Sci. 14: 230-231. 1960) has pointed out, the generic name *Pandanus* was validly, if not lavishly, described in Stickman's dissertation of 1754. However, none of the eleven species that had been described by Rumphius (Herb. Amb. 4: 139-154. 1743) were validated in the dissertation. (Actually, two of those species are now referred to other genera, according to Merrill, Interpret. Rumph. Herb. Amb. 83, 107. 1917.) In cases where a genus is validly published un-

accompanied by the valid description of an included species, the first species described in the genus is often taken as its type species. Most authors have considered the type species of *Pandanus* to be *P. odoratissimus* L. f. (Suppl. Pl. 424. 1781). However, an earlier binomial is definitely referable to the genus, *P. tectorius* Parkinson (J. Voy. Endeavour, 46. 1773). There has been much discussion concerning Parkinson's binomials; the epithets were connected to the generic names by hyphens and therefore the names are considered by some taxonomists to be mononomials and hence invalid. If one declines to accept Parkinson's 1773 names because of a technical idiosyncrasy of an inexperienced printer, there can be no doubt that the binomials (if they meet other requirements of the ICBN) were validly published in a German edition (cf. St. John in Biol. J. Linn. Soc. 4: 305-310. 1972) of a part of Parkinson's work in 1774. In that case, the binomial *P. tectorius* may be ascribed to "Parkinson ex Z" in Naturforscher (Berlin) 4: 250. 1774. In either case *P. tectorius* is older than *P. odoratissimus*. Use of the name *P. tectorius* may indeed be questionable, if one believes that there are several species of sect. *Pandanus* in Tahiti, the type locality, but nevertheless the binomial is accompanied by a description of sorts and is to be considered the type species of *Pandanus*.

DISTRIBUTION: Paleotropical, with at least 600 and probably more than 1,000 species. In the present treatment I recognize twelve species as being indigenous (or aboriginally introduced) in Fiji.

LOCAL NAMES AND USES: As local names in Fiji do not seem to refer to precise individual species of *Pandanus*, they are discussed here and omitted from comments under species. The leaves of any species of the genus may be used for making mats, baskets, etc., and *Pandanus* is an indispensable component of Fijian village life. The staminate inflorescences, especially those of sect. *Pandanus*, are very fragrant and are often used (especially their bracts) for scenting coconut oil. In general, the names *voivoi*, *kiekie*, and *varawa* are used for species of which the leaves are considered best for fine mats, such as sleeping mats, and for small woven baskets and containers. These names perhaps most often denote *P. thurstonii*, *P. joskei*, and *P. whitmeeanus*. *Ndraundreka* and *misimisi* are names mentioned by J. W. Parham for *P. joskei*, but I have not found the original source of such references. *Ndraundreka* is also referred to *P. whitmeeanus* by Parham. *Mbalawa* and *vandra* are referable to any member of sect. *Pandanus*; the leaves of members of this section are considered inferior but are often used to make coarse mats, such as those used on floors of Fijian houses, for room-dividing screens, interior walls, etc. Sometimes, however, the name *vandra* is used more broadly, to designate the members of any section of the genus. The name *mbalaka* was recorded by me as applicable to *P. sinicola*, but since that name usually applies to a palm I assume that *mbalawa* was intended for the *Pandanus*. *Vandu* is noted by St. John as used in the Yasawas for *P. wayaensis*, in the present treatment referred to *P. yasawaensis*.

USEFUL TREATMENTS OF GENUS: St. John, H. Revision of the genus *Pandanus* Stickman. Part 38. *Pandanus* in Fiji, first group (except section *Pandanus*). Pacific Sci. 29: 55-77. 1975. St. John, H. Revision of the genus *Pandanus* Stickman. Part 40. The Fijian species of the section *Pandanus*. Op. cit. 30: 249-315. 1976. Stone, B. C. Notes on the plant genus *Pandanus* in Fiji, Tonga, the New Hebrides, and Niue. Proc. Biol. Soc. Wash. 80: 47-59. 1967. Stone, B. C. Towards an improved infrageneric classification in *Pandanus* (Pandanaaceae). Bot. Jahrb. 94: 459-540. 1974. Stone, B. C. The *Pandanaaceae* of the New Hebrides, with an essay on intraspecific variation in *Pandanus tectorius*. Kew Bull. 31: 46-70. 1976.

Since Fiji is really only toward the fringe of the range of *Pandanus*, comments on an overall arrangement of taxa within the genus are out of place in this *Flora*. Nevertheless one cannot examine even a few taxa of the genus without becoming involved to a limited extent with attempts to divide it into reasonable subgenera and sections. Perhaps the most ambitious of such recent attempts has been that of Stone (1974, cited above), which builds on the classifications proposed by Warburg (in *Pflanzenr.* 3 (IV. 9): 1-97. 1900) and St. John (in *Pacific Sci.* 14: 224-241. 1960). The mentioned authors have been aware that their efforts were preliminary and susceptible to future improvement; it will doubtless be many years before this complex genus is thoroughly understood and a truly definitive system of its classification proposed. Stone recognizes 61 sections arranged in eight subgenera, thus accounting for 468 species, a total which he does not assume to be a final figure for the genus. His specific concepts in *Pandanus* are considerably broader than those of St. John, particularly in respect to sect. *Pandanus*. At this time it is impossible to guess how many species will be described and generally accepted in *Pandanus*, but no doubt the figure will substantially exceed the 600 mentioned by Airy Shaw (in Willis, *Dict. Fl. Pl. Ferns*, ed. 7. 827. 1966).

The Fijian species fall very satisfactorily into five sections (St. John, 1975, cited above). The following key serves to distinguish among these sections, but some comment on their names and circumscription seems required.

Pandanus thurstonii had been assumed to be a member of sect. *Acrostigma* (cf. Stone, 1974, p. 524), but in 1975 St. John (p. 59) proposed for it and a new species, *P. varawa* St. John, a new section *Digitati*. Of the new section *P. varawa* is designated the type species; St. John indicates that the pistillate plants seem inseparable from those of sect. *Acrostigma*, but the staminate specimen that he refers to *P. varawa* is quite different and is the reason for his proposal of sect. *Digitati*. *Pandanus varawa* is known from a single Fijian collection, *Smith 992*, from Koro. However, this collection included both fruiting and staminate plants; St. John indicated the fruiting material as the type and renumbered the staminate portion as 992a. Therefore the typification of *P. varawa* and sect. *Digitati* rests on the fruiting material of *Smith 992*. My field notes for this number indicate that it was collected in shady, swampy forest on the eastern slope of the main ridge of Koro. The precise locality, according to my field journal, was along an old trail leading from Sinuvatha, on the island's east coast, toward Kande, on the west coast. Although at present the villages on Koro are practically all coastal, there are indications in the form of old walls and fortifications that the interior slopes were at one time more frequented. The specimens of *Pandanus* in question were indeed collected in "shady, swampy forest," but I can further indicate that the area covered by *Pandanus* was quite extensive, suggesting that the plants were a remnant of cultivation. Such cultivation is well documented for *P. whitmeeanus*, considered by Fijians the most useful species of the genus for making mats. However, it is also likely that other species were similarly cultivated, or at least encouraged to spread by the elimination of other vegetation in certain selected areas, and it is likely that some of these "gardens" were not limited to a single species. These data are here recorded because I now feel that I erred in assigning the fruiting and staminate plants to a single number; of course this is always a reprehensible practice, and in the present case it is particularly regrettable, because it seems very likely that two distinct species are

represented by my no. 992. One of these species, based on the fruiting material and therefore the type material of *P. varawa* and sect. *Digitati*, seems to me inseparable from *P. thurstonii*. The staminate portion (upon the characters of which the new section was described, even though this portion is not the nomenclatural type) seems almost certainly to represent *P. joskei*, which previously has been known only from fruiting specimens. In my opinion, therefore, sect. *Digitati* must be considered a synonym of sect. *Acrostigma*.

Further evidence that the staminate material of *Smith* 992 belongs with *Pandanus joskei* is the fact that this taxon is one of the two species referred by both St. John and Stone to a section characterized by having its stamens in a fascicle which is distally expanded and bears anthers salient from its margin; this section also has a lateral inflorescence. It may be noted that the staminate inflorescence of *P. varawa* is described as lateral and the infructescence as terminal by St. John. The correct name for this section is sect. *Cauliflora* Stone (in *Malaysian J. Sci.* **1** (A): 124. 1972), which has nomenclatural priority over sect. *Galeatistigma* St. John (in *Pacific Sci.* **27**: 52. 1973). Both authors typify the section by *P. lamprocephalus* Merr. & Perry (Solomon Islands) and include as the second species *P. joskei*, of which staminate material has not previously been known. Recently Stone (in *Kew Bull.* **31**: 50. fig. 1, 2. 1976) has described a third species of this section, *P. halleorum*, from the New Hebrides; the staminate phalanges of this species are essentially like those of *Smith* "992a."

The third section occurring in Fiji is, as far as known at present, endemic. This is sect. *Radiatistigma* St. John (in *Pacific Sci.* **29**: 69. 1975). It consists of three species, two of which were placed by Stone in sect. *Coronata* (in *Bot. Jahrb.* **94**: 521. 1974). The new section, however, seems without doubt to be entirely distinct, and it is now accepted by Stone (in litt.).

Section *Coronata*, however, is represented in Fiji by its type species, *Pandanus whitmeeanus*, a very distinct taxon which probably originated in the New Hebrides and was an aboriginal introduction into Fiji and other archipelagoes. The staminate inflorescence of this species has not been collected, but that of a Philippine species of the section (*P. esculentus* Martelli) has been, and its solitary stamens indicate a close affinity to sect. *Acrostigma*.

The remaining section represented in Fiji, sect. *Pandanus*, is probably the largest and most widespread of the genus. Its species usually occur at low elevation, often directly on beaches; they are characterized by having compound ovaries, the carpels with apical stigmas, and the phalanges with aerenchyma; these phalanges are buoyant and regularly sea-dispersed (St. John in *Pacific Sci.* **30**: 249. 1976). It is in sect. *Pandanus* that the most divergent views as to specific limits are found among "pandanologists." The problem has been discussed at length by Stone (1976, cited above), who believes that comparatively few biological species should be recognized in the section, rather than the several hundred now ascribed to it by St. John. Stone (1967, cited above) considers *P. odoratissimus* L. f. to occur no farther east than Malesia, including the Philippines. Most Pacific species of this affinity he would refer to *P. tectorius* Parkinson, preferring to utilize "the deliberately rather imprecise category variety" to indicate some of the diversity rather than to add to the proliferation of specific names. Personally, I am not convinced that a proliferation of trinomials (or quadrimomials) is any more satisfactory a solution than a prolif-

eration of binomials. The phalanges of members of sect. *Pandanus* are a large and conspicuous component of oceanic drift in the Pacific; they may be observed in windrows on most beaches, and one may feel sure that repetitive drift is the usual means of dispersal in this group of plants. The development of isolating mechanisms, under such conditions, would seem unlikely, although in some instances populations may become discrete through inland migration and subsequent isolation, or by becoming stranded in some comparatively inaccessible coastal habitat.

As to the Fijian taxa of sect. *Pandanus*, one may assume that St. John's (1976, cited above) grouping of the 26 recognized species into larger clusters is indicated by their position in his key, although many of the species are said to be most closely related to taxa not indigenous in Fiji. Primary grouping deals with whether the apex of the phalange is truncate or subtruncate vs. convex; the size of phalanges (which in the Fijian members of the section vary in length from 2.5 to 9.7 cm.); the shape of phalanges; the number of carpels per phalange; whether or not the apices of marginal carpels have concave distal platforms; degree of distal separation of carpels; leaf width; number of secondary veins in the leaf; and length and direction of marginal prickles of the leaf. Whether or not combinations of these and other characters have any basic biological significance is questionable; for instance, one of the recently described species, *P. patulior* St. John, is keyed under three different major divisions, suggesting that phalange variation in a single plant may be embarrassingly flexible. It cannot be doubted that differences pertaining to the above listed and other characters exist when any two individual plants of sect. *Pandanus* are carefully compared, and students of the genus are indebted to St. John for his meticulous descriptions and illustrations of recognized entities. However, in view of the constant interchange of genetic material that is presumably taking place, it seems doubtful whether differences are of any more than individual consequence. New combinations of characters are to be anticipated in practically every individual plant that is carefully examined. Consequently, it would seem unrealistic to group the individuals into meaningful taxa that are conceivably separated from one another by isolating mechanisms. Any grouping would seem subjective, perhaps due to the accidents of the availability of material more than to biologically consequential criteria. Utilizing fruit morphology as the primary basis, I am able to recognize only five reasonably discrete species of sect. *Pandanus* in Fiji; even these may eventually prove better placed in *P. tectorius*, although some confidence is felt in the biological reality of at least the first two discussed below. For the variable "residue" I have adopted the name *P. pyriformis* (Martelli) St. John, based on one of the older epithets typified by a Fijian specimen. This comprehensive taxon will probably be referred to *P. tectorius* in the future, but for the present I defer use of that somewhat controversial epithet.

I am indebted to B. C. Stone for his kind review of the preceding few paragraphs. Although he is in general agreement with the thoughts expressed, the conclusions are my own responsibility.

KEY TO SPECIES

Fruits all (or mostly) 1-celled, maturing as 1-seeded drupes.

Stigmas (in our species) longer than broad, linear, nearly as long as the subulate style; drupes oblongoid, 4–5 times longer than broad; staminate spikes (although not known in our species) with many stamens singly attached to the axis or in triads only very slightly joined at base; unbranched trees with terminal inflorescences (at least our species) (sect. *Acrostigma*). 1. *P. thurstonii*

Stigmas broader than long.

Style projecting from margin of apical depression of drupe, its margin rounded but 4-9-lobed, the stigma forming a ligulate band under the overhanging style; drupes cuneiform, 3-4 times longer than broad; stamens (2-) 5-8 in a fascicle composed of an erect column distally expanded, this sometimes bent, bearing the anthers salient from its margin; unbranched or few-branched trees with lateral or axillary inflorescences (sect. *Cauliflora*).

Tree 3-10 m. high; infructescence lateral from trunk below terminal cluster of leaves, the peduncle more than 14 cm. long and apparent, the cauline peduncular bracts 16-19 cm. long, linear-lanceolate, the upper bracts decreasing slightly in size; intact syncarp not known but enclosed by lanceolate to ovate-lanceolate bracts about 15 × 7 cm.; drupes 60-68 mm. long, 16-25 mm. broad, 17-19 mm. thick; style 5-8 mm. broad and 1-3 mm. long, the stigma 6-10 mm. broad; seed 12-13 mm. long. 2. *P. joskei*

Tree 1.3-3.3 m. high; infructescence axillary in terminal cluster of leaves, the peduncle 12-14 cm. long, together with the syncarp concealed by leaf bases and debris, the lowermost peduncular bracts about 4 cm. long, ovate-lanceolate, the upper bracts progressively larger, the uppermost about 10 cm. long; syncarp ovoid, about 10 × 8 cm., enclosed by ovate bracts about 9 × 5 cm.; drupes 31-38 mm. long, 11-17 mm. broad, 6-13 mm. thick; style 3.5-5 mm. broad and 2-4 mm. long, the stigma 3.5-5 mm. broad; seed 4-5 mm. long. 3. *P. taveuniensis*

Style none, the stigmas sessile on the concave apex of drupe, filling all spaces between several hard, cordate pseudostigmas and extending down the outer sides of drupe as radiating lines or ellipses; drupes ellipsoid to oblanceoloid, 5- or 6-angled, about twice as long as broad; staminate inflorescences not known; unbranched or few-branched trees (sect. *Radiatistigma*).

Drupes comparatively large, 5.5-6 cm. long, 2.7-3.5 cm. broad, 2.6-3.2 cm. thick, the apex 8-17 mm. broad, the stigma 14-25 mm. in diameter; seed cavity central, the endocarp 5-9 mm. thick, bony, the seed obovoid, about 17 × 13 mm.; syncarp ellipsoid-subglobose, about 16.5 × 14 cm. or 15 cm. in diameter. 4. *P. vitiensis*

Drupes smaller, 2.6-3.8 cm. long, 1.5-2.4 cm. broad, 1-2 cm. thick; syncarp ellipsoid, 7.5-10.5 × 6-8.5 cm.

Apex of drupe 4-8 mm. broad, the stigma 8-10 mm. in diameter; seed cavity central, the endocarp 4-8 mm. thick, bony. 5. *P. levuensis*

Apex of drupe 6-16 mm. broad, the stigma 14-17 mm. in diameter; seed cavity in lower part of drupe, the endocarp thin, cartilaginous. 6. *P. gillespiei*

Fruits several-celled; freely branched trees.

Stigmas oblique to vertical on the distal, outer face of phalange apex; staminate inflorescences (of our species) not known (sect. *Coronata*). 7. *P. whitmeeanus*

Stigmas apical on carpel summits; stamens connate in phalanges, racemously arranged (sect. *Pandanus*).

Carpels 3 or 4 per phalange; phalanges narrowly oblong-ovoid, 2.5-3 cm. long, 1.4-2 cm. broad, 1.1-1.2 cm. thick; syncarp subglobose, 9-12 cm. in diameter, with about 48 phalanges. 8. *P. sinicola*

Carpels 5 or more per phalange; phalanges more than 3 cm. long, 1.6 cm. broad, and 1.2 cm. thick; syncarp (as far as known) usually ellipsoid, sometimes subglobose, more than 13.5 cm. in diameter and with 38-90 phalanges (syncarps with attached phalanges infrequently available in collections).

Phalanges comparatively short, cuneate, 3-4.2 cm. long, 1.6-3.8 cm. broad, 1.2-2.7 cm. thick, with 6-10 carpels. 9. *P. yasawaensis*

Phalanges longer, more than 4.5 cm. long, 2.3 cm. broad, and 1.6 cm. thick, with 5-15 carpels.

Carpels pyramidal to pyramidal-lanceoloid at apex; phalanges elongate and comparatively narrow, prismatic or narrowly oblanceoloid, 6.2-8.7 cm. long, 2.7-3.6 cm. broad, 1.6-3.2 cm. thick, the apex truncate and distinctly narrower than the midportion. 10. *P. alveatus*

Carpels hemispheric to ovoid (or if pyramidal broadly so, rarely lanceoloid) at apex; phalanges variously shaped but not proportionately elongate nor notably narrower at apex than at midportion.

Apical portions of carpels appearing conspicuously free from one another and sometimes slightly curved outward, the central apical sinuses 8-10 (-28) mm. deep; phalanges 5.4-9.7 cm. long, with 7-11 carpels. 11. *P. moalaensis*

Apical portions of carpels less conspicuously free from one another, not curved, the central apical sinuses 1-7.5 mm. deep. 12. *P. pyriformis*

1. *Pandanus thurstonii* Wright in Kew Bull. 1894: 348, as *P. thurstoni*. 1894; Warb. in Pflanzenr. 3 (IV. 9): 81. 1900; Martelli in Webbia 4: 35. 1913, in Univ. Calif. Publ. Bot. 12: 335. 1930; Stone in Proc. Biol. Soc. Wash. 80: 49. 1967.

FIGURE 97.



FIGURE 97. *Pandanus thurstonii*, from Smith 992; a terminal, spicate infructescence, with several syncarps, being held in an inverted position, $\times 1/5$.

Pandanus thurstoni Wright ex A.C. Sm. in Bishop Mus. Bull. **141**: 12, fig. 4, a, e, excl. descr. δ infl. 1936; J. W. Parham, Pl. Fiji Isl. 283. 1964, ed. 2. 377. 1972; St. John in Pacific Sci. **29**: 61, fig. 339. 1975.

Pandanus varawa St. John in Pacific Sci. **29**: 61, quoad typum et fig. 340, parte δ excl. 1975.

Pandanus thurstonii is an unbranched tree to 7 m. high, with apically densely congested leaves and terminal inflorescences; staminate material is not yet known.

TIPIFICATION AND NOMENCLATURE: The holotype is *Thurston s. n.* (κ), said to have been collected "about 2 hours from Suva." The type locality, therefore, is Viti Levu, but the material could have been obtained in either Rewa or Naitasiri Province, or possibly even in southern Namosi or Tailevu Province. *Pandanus varawa* is typified by the fruiting portion of a mixed collection, Smith 992 (BISH HOLOTYPE; many ISO-TYPES), collected Jan. 29, 1934, on the eastern slope of the main ridge inland from Sinuvatha, Koro. In my discussion of the genus, above, I indicate some details regarding the Koro collection.

DISTRIBUTION: The species is endemic to Fiji and is known only from the two type collections, from southeastern Viti Levu and Koro. On the latter island the species was found in shady, swampy forest at an elevation of 300–500 m. No habitat information is available as to the Thurston collection.

2. *Pandanus joskei* Horne, A Year in Fiji, 265, nom. nud. 1881; Horne ex Balf. f. in J. Linn. Soc. Bot. 20: 416. 1883; Drake, Ill. Fl. Ins. Mar. Pac. 323. 1892; Warb. in Pflanzenr. 3 (IV. 9): 73. 1900; Gibbs in J. Linn. Soc. Bot. 39: 178. 1909; Martelli in Webbia 4: 18. pl. 24, fig. 1-3. 1913, in Univ. Calif. Publ. Bot. 12: 334. 1930; J. W. Parham, Pl. Fiji Isl. 283. 1964, ed. 2. 376. 1972; Stone in Proc. Biol. Soc. Wash. 80: 50. 1967; St. John in Pacific Sci. 29: 64. fig. 342. 1975.

Pandanus varawa St. John in Pacific Sci. 29: 61, quoad partem ♂ et fig. 341, typo excl. 1975.

Pandanus joskei is an unbranched or few-branched tree up to 10 m. in height (or higher; Gibbs remarks that it "runs up with the forest trees to a great height"); its inflorescences and infructescences are borne laterally from the trunk below the terminal cluster of leaves. It is a forest species, occurring at elevations up to about 900 m.; its lower altitudinal level is not known, but it is scarcely to be expected at sea level.

TIPIFICATION AND NOMENCLATURE: As discussed by St. John in 1975, Horne sent a rough sketch and some notes about this species to Balfour, but apparently he did not prepare a specimen. The notes and sketch are not now to be located at K, but Balfour's description permits recognition of the species. As neotype St. John has designated *Parks 20344* (FI; many *ISONEOTYPES*), collected June 11, 1927, in a canyon below the summit of Mt. Korombamba, Rewa Province, Viti Levu. I have already indicated that *Smith 992*, from Koro, is a mixed collection, of which the typical (fruiting) portion is referable to *Pandanus thurstonii*, while the ♂ portion appears to represent *P. joskei*. In 1967 Stone indicated *Yeoward* (K) as the holotype; this specimen was sent by Yeoward to Kew with a letter addressed to M. A. Morris and dated Aug. 3, 1893. I do not consider that Stone was formally designating a neotype.

DISTRIBUTION: Endemic to Fiji and thus far known only from Viti Levu and Koro.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Vicinity of Nandarivatu, *Gibbs 871*, *Gillespie 3734*, p. p. NAITASIRI and REWA: *Yeoward* (data from accompanying letter dated Aug. 3, 1893), sources of Tamavua River (Naitasiri), also between Waimanu and Rewa Rivers (Rewa). REWA: Mt. Korombamba, *DA 16548*. KORO: Eastern slope of main ridge, *Smith 992* ♂ (renumbered *992a* by St. John). FIJ without further locality (but probably from southeastern Viti Levu), *Thurston*, with letter dated April 3, 1894.

The cited specimens are all in fruit except the one from Koro. *Gillespie 3734*, p. p. (BISH), from the vicinity of Nandarivatu, undoubtedly represents *Pandanus joskei*, although St. John in 1975 did not cite it as such. Further remarks on the Gillespie specimens numbered *3734* will be found below in the discussion of *P. gillespiei*.

3. *Pandanus taveuniensis* St. John in Pacific Sci. 29: 67. fig. 343. 1975.

This recently described species is a tree to 3.3 m. high, with a simple, unbranched stem and a terminal cluster of spiralled leaves; infructescences are axillary among the leaves and are completely hidden by their bases and by an accumulation of debris. It occurs in dense forest at an elevation of 700-840 m.

TIPIFICATION: The holotype is *DA 16932* (coll. Smith, J. W. Parham, Tomlinson, et al.) (BISH), collected May 2, 1969, on the steep western slope of Taveuni above Nggathavulo Estate at an elevation of about 840 m.

DISTRIBUTION: Endemic to Fiji and thus far known only from the type collection, of which several duplicates are available.

The discovery of this species made an immediate impression on members of the collecting party (J. W. Parham, P. B. Tomlinson, myself, and several Fijian assistants from the Department of Agriculture). Having made various ascents of different parts

of the western slope of Taveuni, I was quite unprepared for the occasional *Pandanus* trees that we began to see in the forest at an elevation of about 700 m. These trees had unbranched trunks and terminal crowns of closely spiralled leaves, being quite unlike any *Pandanus* I had previously collected. To our disappointment all were sterile. Slightly higher we began to see increasing numbers of the plant, and at an elevation of about 840 m. there were dozens of them under the canopy of the very dense, sharply sloping forest. All seemed sterile, but as we looked more closely and began to dig into the debris that profusely covered the leaf bases we were amazed to find completely hidden syncarps. In fact, every tree seemed to be in full fruit. No staminate inflorescences were found. So impressed were we by the unique appearance and habit of these plants that we all felt certain that they represented a novelty. As it now appears, the relationship to *P. joskei* is close, but many differences separate the two taxa.

4. *Pandanus vitiensis* Martelli in Univ. Calif. Publ. Bot. **12**: 333, pl. 42. 1930; Perry in J. Arnold Arb. **31**: 208. 1950; J. W. Parham, Pl. Fiji Isl. 283. 1964, ed. 2. 377. 1972; Stone in Proc. Biol. Soc. Wash. **80**: 53, excl. syn. *P. levuensis*. 1967; St. John in Pacific Sci. **29**: 75, fig. 346. 1975. FIGURES 29,30 (upper).

This striking species is an unbranched or few-branched tree 5–15 m. high, presumably without prop roots, bearing tufts of spiralled leaves and terminal infructescences at the apex of its trunk or branches; the trunk is 10–20 cm. in diameter. Staminate inflorescences are unknown, but the syncarp is subglobose to ellipsoid, about 15 cm. in diameter or about 16.5×14 cm. When fresh, the drupes are grayish on their exposed surfaces; their contiguous surfaces are bright red distally and reddish yellow proximally. *Pandanus vitiensis* is a forest species, occurring at elevations from near sea level to about 970 m.

TYPEFICTION: The type is *Parks 20980*, collected between May and July, 1927, at Tholo-i-suva, Naitasiri Province, Viti Levu. Martelli did not designate the depositary of the holotype, but St. John in 1975 indicated the specimen at UC as the holotype; there are many isotypes. Parks's first set is deposited at UC, and in drawing up his original description Martelli had the entire series of the number at hand.

DISTRIBUTION: Endemic to Fiji and thus far known only from Viti Levu.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Southern slopes of Mt. Ndelainathovu, on the escarpment west of Nandarivatu, *Smith 4917*. NAMOSI: Near Namelimeli Village, *DA 18570*. NAITASIRI: Prince's Road, near Tholo-i-suva, *Setchell & Parks 15054*; Toninaiwau, Tholo-i-suva, *DA16697*. NAITASIRI or REWA: "Vicinity of Suva," *Meebold 8192*. VITI LEVU without further locality (but probably from the vicinity of Nandarivatu, Mba Province), *Gillespie 3734.5*.

5. *Pandanus levuensis* Martelli in Univ. Calif. Publ. Bot. **12**: 334, pl. 44 (excl. pl. 43). 1930; J. W. Parham, Pl. Fiji Isl. 283. 1964, ed. 2. 376. 1972; Stone in Proc. Biol. Soc. Wash. **80**: 53, pro syn. *P. vitiensis*. 1967; St. John in Pacific Sci. **29**: 72, fig. 345. 1975.

Pandanus levuensis is a slender, few-branched tree 3–5 m. high, bearing terminal tufts of spiralled leaves and an infructescence at the tips of its branches. The peduncle of the syncarp is 18–30 cm. long, trigonous, and with numerous leafy bracts. The syncarp is ellipsoid, 7.5–10.5 cm. long and 6–8.5 cm. in diameter. The fresh drupes are grayish on their exposed surfaces; notes are not available as to the color of the appressed, proximal surfaces. Like the preceding, this is a forest species, known only from an altitude of about 300 m.

LECTOTYPEFICTION: Martelli based his species on two collections, illustrated by his plates 43 and 44. Both Stone in 1967 and St. John in 1975 designated *Parks*

20345 as the lectotype, excluding the other cited collection (*Gillespie 3443.1*, pl. 43) from the species. St. John further indicated the Parks specimen at UC as the lectotype; there are many isolectotypes. This collection was made between May and July, 1927, on Mt. Korombamba, Rewa Province, Viti Levu.

DISTRIBUTION: Endemic to Fiji and thus far known only from the type locality.

AVAILABLE COLLECTION: VITI LEVU: REWA: Mt. Korombamba, DA 16549.

Stone's reduction of this species to *Pandanus vitiensis* cannot be accepted. It clearly differs from that in its much smaller syncarp and drupes at maturity, as well as in the narrower apices of its drupes.

6. *Pandanus gillespiei* St. John in Pacific Sci. 29: 69. fig. 344. 1975.

Doubtless a tree, but known only from leaves and an infructescence. The peduncle of the syncarp is more than 34 cm. long, trigonous, and with numerous leafy bracts much exceeding the syncarp, which is ellipsoid and about 9.5×8 cm. The drupes are about the size of those of the preceding species, but they are distinctly broader at apex and have the seed cavity much lower, the endocarp being thin and cartilaginous rather than bony.

TIPIFICATION: The holotype is *Gillespie 3734*, p. p. (UC; ISOTYPE at FI), collected Nov. 14, 1927, in the vicinity of Nandarivatu, Mba Province, Viti Levu. A specimen not cited by St. John, but with identical label data, is *Gillespie 3734A* (BISH); this is doubtless another isotype. The probability that *Gillespie 3443.1*, the basis of Martelli's plate 43, is also a part of the same collection is discussed below.

DISTRIBUTION: Endemic to Fiji and probably known only from the type collection, obtained at an elevation of about 900 m.

In his description St. John suggests that the endocarp of the available collection is immature, but it appears to me that the drupes of *Gillespie 3734A* are quite mature, and that the position of the seed cavity and the thin endocarp are characters of use in separating this species from the preceding; the apex of the drupe and the stigma are also substantially broader than those of *Pandanus levuensis*.

Considerable confusion surrounds the *Pandanus* material collected by Gillespie in the vicinity of Nandarivatu, where he spent an extended period. It seems probable to me that he collected one intact syncarp and associated foliage in that area, and also fallen drupes of two other species, assigning all of them to no. 3734. One specimen so labelled (BISH), of detached drupes only, definitely represents *P. joskei*. Two other specimens with the number 3734 (FI, UC) are the basis of St. John's new species *P. gillespiei*; presumably the UC specimen has an intact syncarp. It is probable that Gillespie, sorting his specimens after he returned to California from Fiji, discovered the mixture in his material numbered 3734 and attempted to remedy the situation, leaving the number 3734 for *P. joskei*. A specimen at BISH which is renumbered as 3734A was not cited by either Martelli or St. John, but it is definitely assignable to *P. gillespiei*; probably the FI and UC specimens of that species had been distributed before Gillespie discovered the mixture and consequently he did not have an opportunity to renumber them as 3734A. Other detached drupes assigned the number 3734 were renumbered 3734.5; these (at BISH and UC) represent *P. vitiensis*, as which they were cited by St. John. Although no locality is given on their labels, one may assume that the specimens renumbered 3734.5 also came from the Nandarivatu area. A further complication concerns the material labelled *Gillespie 3443.1*, indicated as from the vicinity of Nasinu (Naitasiri Province). Martelli's photographic

plate 43 was made from no. 3443.1 and assigned by Martelli to *P. levuensis*. St. John correctly removed the illustration from his concept of *P. levuensis*, but he did not account for no. 3443.1 elsewhere. It is quite possible that Gillespie, while sorting his material, may have found these detached drupes without any data at all and arbitrarily numbered them 3443.1, depending upon his memory for the Nasinu locality. (Decimal numbers of Gillespie were apparently often assigned by him to specimens that had become detached from data, and therefore the localities are not entirely reliable.) I suspect that no. 3443.1 is actually a part of no. 3734A and came from Nandarivatu rather than Nasinu. No specimen labelled no. 3443.1 is at BISH, but Martelli's plate 43 clearly illustrates the drupes of Gillespie 3734A (BISH); presumably it was prepared from material numbered 3443.1 at either FI or UC.

7. *Pandanus whitmeeanus* Martelli in Webbia **1**: 364. 1905, in op. cit. **4**: 36. pl. 22, fig. 4-6. 1913; Setchell in Carnegie Inst. Wash. Publ. **341**: 117. 1924; Martelli in Univ. Calif. Publ. Bot. **12**: 359. pl. 45, fig. 8, 9. 1930, in Occas. Pap. Bishop Mus. **10** (13): 23. 1934; Yuncker in Bishop Mus. Bull. **220**: 50. 1959; St. John in Pacific Sci. **14**: 228. 1960; Stone in Proc. Biol. Soc. Wash. **80**: 50. fig. 1. 1967; St. John & A.C. Sm. in Pacific Sci. **25**: 345. 1971; J.W. Parham, Pl. Fiji Isl. ed. 2. 378. 1972; B.E.V. Parham in New Zealand Dept. Sci. Indust. Res. Inform. Ser. **85**: 97. 1972; Stone in Bot. Jahrb. **94**: 520. 1974; St. John in Pacific Sci. **29**: 56. fig. 337, 338. 1975. FIGURES 98, 99.

Pandanus corallinus Martelli in Univ. Calif. Publ. Bot. **12**: 359. pl. 45, fig. 10-12. 1930; Yuncker in Bishop Mus. Bull. **220**: 50. 1959; St. John in Pacific Sci. **14**: 228. 1960; Stone in Proc. Biol. Soc. Wash. **80**: 53. 1967.

A freely branched tree to 15 m. tall, but also observed as an unbranched tree when young, each branch bearing a tuft of spiralled leaves and a terminal inflorescence. Staminate inflorescences are not known. The syncarps are solitary, with peduncles to 27 cm. long and several foliaceous bracts; they are subglobose to ellipsoid, up to 25 × 22 cm. This species, considered the best *Pandanus* in Fiji for making fine mats and handicraft articles, is found near sea level in swampy, grassy areas and on the edge of forest. The phalanges are reported to be coral red when mature.

TYPEFICTION AND NOMENCLATURE: The holotype is *Whitmee* (K), collected in February, 1878, in Samoa but without further data. *Pandanus corallinus* is typified by nine detached phalanges taken from a necklace worn by a Tongan woman on Tongatapu, assigned the number *Setchell & Parks 15420*, in June, 1926. Material of this number is deposited at UC and FI; since the first set of the Setchell and Parks collections is at UC, that specimen should doubtless be considered the holotype. St. John in 1975 first pointed out the synonymy of the two binomials.

DISTRIBUTION: The species is known from the New Hebrides, Fiji, the Horne Islands, Samoa, Tonga, and the Cook Islands. In Fiji it occurs abundantly in flat, open areas near the south coast of Viti Levu between Serua and Rewa Provinces. Considerable numbers of specimens may be observed from the Queen's Road (including the portion that traverses southern Namosi Province, although no collections are available from there), and the plant gives every indication of being a remnant of cultivation. St. John in 1975 suggested that the species was an aboriginal introduction into the archipelagoes extending from Fiji to the Cook Islands; this seems extremely plausible, as does its possible indigenous occurrence in the New Hebrides.

AVAILABLE COLLECTIONS: VITI LEVU: SERUA: Flat coastal strip in vicinity of Ngaloa, *Smith 9436*. REWA: Queen's Road 8 miles west of Suva, *DA 10092*; coastal road (presumably west of Suva), *Meebold 26529*.



FIGURE 98. *Pandanus whitmeeanus*, from Smith 9436; distal portion of a branch, bearing a solitary syncarp, \times about $1/8$.



FIGURE 99. *Pandanus whitmeeanus*, from Smith 9436; a syncarp, \times about $1/2$.



FIGURE 100. *Pandanus sinicola*, from Smith 1494; distal portion of a branch, bearing a solitary, terminal syncarp, $\times 1/3$.

8. *Pandanus sinicola* A.C. Sm. in Bishop Mus. Bull. **141**: 13. fig. 4, b-d, f, as *P. sinicolus*. 1936; St. John in Pacific Sci. **30**: 297. fig. 385. 1976. FIGURE 100.

Pandanus sinicolus A.C. Sm. ex J. W. Parham, Pl. Fiji Isl. 283. 1964, ed. 2. 376. 1972.

A branching tree 2-4 m. high, the branchlets terminating in densely spiralled leaves and a solitary syncarp, the peduncle short or essentially none, the syncarp subglobose, 9-12 cm. in diameter and with about 48 phalanges, these small and 3- or 4-carpellate.

TYPEFICTION: The holotype is *Smith 1494* (BISH; many ISOTYPES), collected April 2, 1934, forming small, compact thickets on a limestone cliff slightly above sea level, in the northern "Bay of Islands" portion of Vanua Mbalavu.

DISTRIBUTION: Endemic to Fiji, and thus far known only from the type collection.

This taxon seems to be the most distinctive Fijian *Pandanus* in sect. *Pandanus*, being the only species known from the archipelago with such small syncarps and phalanges and so few carpels per phalange. Its evolution might be thought difficult to explain, since there are literally thousands (or tens of thousands) of individuals of sect. *Pandanus* in the Lau Group of Fiji. However, most such individuals are found on beaches or on grassy, coastal slopes, situations in which repetitive oceanic drift prevents the evolution of well-marked taxa. The limestone "Bay of Islands" region of Vanua Mbalavu is characterized by a lack of beaches and by sharply undercut shore lines and islets (FIGURE 14). In such a situation it is likely that one or a few waif phalanges became stranded above an undercut shore line. Long isolation, without the introduction by storms of other phalanges, could permit the evolution of a distinct form. In other parts of Lau where undercut limestone is frequent (cf. FIGURE 13, lower), I have not noted populations of *Pandanus*, nor are such collections available. However, these microenvironments should be searched for unusual individuals of sect. *Pandanus*.

9. *Pandanus yasawaensis* St. John in Pacific Sci. **30**: 313. fig. 394. 1976.

Pandanus wayaensis St. John in op. cit. **30**: 311. fig. 393. 1976.

Trees about 6 m. high (as far as recorded) and with trunks about 20 cm. in diameter, the staminate inflorescence unknown; intact syncarps not available; phalanges cuneate, comparatively small, with 6-10 carpels, the endocarp median or in lower 2/5, the seeds 9-12 mm. long.

TYPEFICTION AND NOMENCLATURE: The holotype is *St. John 18138* (BISH), collected July 20, 1937, in Nakawa Gulch, west side of Mbatinaremba, Waya Island, Yasawa Group, Fiji. The holotype of *P. wayaensis* is *St. John 18132* (BISH), collected on the same date and at the same place. The syncarps of the two specimens are essentially similar except for the slightly different position of the endocarp and the proportionate thickness of the apical and basal mesocarp.

DISTRIBUTION: Endemic to Fiji; thus far known from Waya Island in the Yasawas and from the vicinity of Singatoka, Viti Levu. The two type collections were obtained on an open, rock slope and on the edge of woods respectively, at an elevation of 275-335 m. The Singatoka specimen, not included in St. John's treatment, came from sand dunes near sea level.

AVAILABLE COLLECTION (other than types): VITI LEVU: NANDRONGA & NAVOSA: Sand dunes near Singatoka, *DA 10187* (BISH, SUVA).

Although differences among the three available collections appear to me to be minor and individual in nature, the collections constitute a quite distinct taxon char-

acterized by phalanges smaller than those of any other Fijian member of sect. *Pandanus* except the preceding species. The two type collections are the only available specimens of *Pandanus* from the Yasawas. One might suppose that their evolution resulted from isolation in a "stranded" situation at an elevation higher than usual for sect. *Pandanus*. The Singatoka occurrence may have resulted from a waif introduction by oceanic drift and ecological isolation in an environment unusual for the genus.

I think it likely that a careful study of sect. *Pandanus* in the Fijian Region as a whole will indicate that *Pandanus brachus* St. John (in Pacific Sci. 29: 390, fig. 357, 358A, 358B. 1975), from Rotuma, will accommodate the specimens here referred to *P. yasawaensis*.

10. *Pandanus alveatus* St. John in Pacific Sci. 30: 251, fig. 364. 1976.

Pandanus elongatus St. John in op. cit. 30: 256, fig. 366. 1976.

Trees to 5 m. high and with small prop roots (as far as known) and with trunks 18–20 cm. in diameter, occurring near sea level, the staminate inflorescences unknown; intact syncarps not available; phalanges of moderate length for sect. *Pandanus* but comparatively narrow, the apex distinctly narrower than the midportion, the carpels 5–11, the endocarp slightly above the middle, the seeds 8–15 mm. long.

TIPIFICATION AND NOMENCLATURE: The holotype is *Kondo 3* (BISH), collected Oct. 28, 1968, on Vatoa, in the Lau Group, Fiji. *Pandanus elongatus* is typified by *DA 10450* (coll. M. Miller) (BISH HOLOTYPE; ISOTYPES at K, MASS, SUVA), collected (free phalanges only) Aug. 13, 1956, on Naitamba, also in the Lau Group.

DISTRIBUTION: Endemic to Fiji and thus far known only from the two type collections, both of which lack habitat data.

Although a slight difference in phalange shape is evident between the two available collections, they agree in essential features. They seem to constitute a reasonably distinct taxon by virtue of their comparatively narrow phalanges with unusually narrow apices and with carpels pyramidal or pyramidal-lanceoloid at the free apices.

11. *Pandanus moalaensis* St. John in Pacific Sci. 30: 270, fig. 372. 1976.

Pandanus vatoaensis St. John in op. cit. 30: 309, fig. 392. 1976.

Trees to 8 m. high and with many large prop roots (as far as known) and with trunks about 25 cm. in diameter, occurring at elevations up to about 18 m., the staminate inflorescences unknown; syncarp (as far as known) solitary, ellipsoid, about 20 × 15 cm.; phalanges cuneiform, 5.4–9.7 cm. long, 2.7–5.5 cm. broad, and 1.8–4 cm. thick, broadest distally, the carpels 8–11, apically conspicuously free from one another, the central apical sinuses 8–10 (–28) mm. deep, the endocarp median or slightly above the middle, the seeds 13–20 mm. long.

TIPIFICATION AND NOMENCLATURE: The holotype is *Kondo "M. B."* (BISH), collected Oct. 4, 1968, at Naroi, Moala, in the Lau Group, Fiji. *Pandanus vatoaensis* is typified by *Kondo "Vatoa 2"* (BISH HOLOTYPE; ISOTYPE at K), collected Oct. 28, 1968, on a flat bordering a low limestone ridge, Matasuva, Vatoa, also in the Lau Group.

DISTRIBUTION: Endemic to Fiji and thus far known only from the two type collections.

Differences between the two available collections seem fairly superficial to me, although the phalanges of *Pandanus vatoaensis* are considerably the larger. The taxon is primarily characterized by having the carpels of its phalanges conspicuously free from one another distally, the central apical sinuses of the phalanges being un-

usually deep. The taxon is maintained as distinct from the following with considerable diffidence.

12. *Pandanus pyriformis* (Martelli) St. John in Pacific Sci. **30**: 289, fig. 382. 1976.
FIGURE 101.

Pandanus odoratissimus var. *pyriformis* Martelli in Univ. Calif. Publ. Bot. **12**: 332, pl. 40. 1930; J. W. Parham, Pl. Fiji Isl. 283. 1964, ed. 2. 376. 1972.

Pandanus odoratissimus var. *suvaensis* Martelli in Univ. Calif. Publ. Bot. **12**: 332, pl. 41. 1930; J. W. Parham, Pl. Fiji Isl. 283. 1964, ed. 2. 376. 1972.

Pandanus crassiaculeatus St. John in Pacific Sci. **30**: 254, fig. 365. 1976.

Pandanus kraussii St. John in op. cit. **30**: 258, fig. 367. 1976.

Pandanus lambasaensis St. John in op. cit. **30**: 260, fig. 368. 1976.

Pandanus lauensis St. John in op. cit. **30**: 263, fig. 369. 1976.

Pandanus matukuensis St. John in op. cit. **30**: 266, fig. 370. 1976.

Pandanus mhalawa St. John in op. cit. **30**: 269, fig. 371. 1976.

Pandanus nandiensis St. John in op. cit. **30**: 272, fig. 373. 1976.

Pandanus onoilauensis St. John in op. cit. **30**: 275, fig. 374. 1976.

Pandanus ovalauensis St. John in op. cit. **30**: 277, fig. 375. 1976.

Pandanus pansus St. John in op. cit. **30**: 279, fig. 376. 1976.

Pandanus parhamii St. John in op. cit. **30**: 281, fig. 377. 1976.

Pandanus patulior St. John in op. cit. **30**: 284, fig. 378-381. 1976.

Pandanus rhizophorensis St. John in op. cit. **30**: 293, fig. 383. 1976.

Pandanus seruaensis St. John in op. cit. **30**: 294, fig. 384. 1976.

Pandanus smithii St. John in op. cit. **30**: 298, fig. 386. 1976.

Pandanus subhumerosus St. John in op. cit. **30**: 300, fig. 387. 1976.

Pandanus suvaensis St. John in op. cit. **30**: 302, fig. 388, 389. 1976.

Pandanus vandra St. John in op. cit. **30**: 305, fig. 390, 391. 1976.

Branched trees 4-12 m. high, usually with prop roots, the trunk 12-25 cm. in diameter and often prickly; leaves clustered at apices of branches, 85-180 cm. long, 5-10 cm. broad at base; ♂ inflorescences (as far as known) terminal, pedunculate, often more than 40 cm. long, with thick, chartaceous, white bracts subtending 6-17 lateral spikes, these 4-10 cm. long, the stamens in dendritic fascicles of about 20-50; syncarp terminal, solitary, globose to ellipsoid, as far as known 17-26 cm. long and 13.5-20 cm. in diameter; phalanges (as far as known) 38-90 per syncarp, pyriform to oblanceoloid or broadly obovoid, 4.5-8.2 cm. long, 2.3-6.7 cm. broad, 1.7-4.6 cm. thick, not appreciably narrower at apex than at midportion; carpels 5-15 per phalange, usually hemispheric to ovoid or low-convex at apex, the endocarp median or slightly or distinctly suprmedian, the seeds 6-19 mm. long. The abundant Fijian species of sect. *Pandanus*, which I am here referring to *P. pyriformis*, is usually found at or slightly above sea level, but often at an elevation of 200 m. and occasionally as high as 400 m. Most often it is a common component of beach vegetation, also found among coconuts, on sea cliffs, on the edges of mangrove swamps, and along streams near the coast; when it occurs inland (although never very far from the coast) it is seen on grassy forehills, on grassy ridges, and in open swamps. Its fragrant ♂ inflorescences have white anthers, and the phalanges become pale yellow to orange-red at maturity. Flowering and fruiting specimens are seen throughout the year.

TIPIFICATION AND NOMENCLATURE: *Pandanus odoratissimus* var. *pyriformis* was described twice as a "new variety" in the same paper, once as noted above and later (in op. cit. **12**: 358, pl. 45, fig. 6, 7. 1930) based on a Tongan collection. St. John in 1976, in making his new combination, chose the Fijian material as the lectotype: *Setchell 15668* (UC; several ISOLECTOTYPES), collected Sept. 2, 1926, on shore near Suva, Rewa Province, Viti Levu. Typification of the 18 taxa that I am combining with *P. pyriformis* is as follows. The lectotype of *P. odoratissimus* var. *suvaensis* (and *P. suvaensis*) was indicated by St. John in 1976 as the fruiting portion of *Parks 20876* (K LECTOTYPE; many ISOLECTOTYPES), collected between May and July, 1927, along the strand at Suva, Rewa Province, Viti Levu. The holotype of *P. crassiaculeatus* is *D.A.*



FIGURE 101. *Pandanus pyriformis*, from Smith 9338; distal portion of a branch, bearing a solitary, terminal syncarp, \times about $1/4$.

10277 (coll. D. Koroiveibau) (BISH; isotypes at K, MASS, SUVA), collected July 25, 1956, near Korokula, Queen's Road, Nandronga & Navosa Province, Viti Levu. *Pandanus kraussii* is typified by *Krauss 1301* (BISH), collected Dec. 28, 1969, on seashore at Levuka, Ovalau. The type of *P. lambasaensis* is *DA 10462* (coll. D. Koroiveibau) (SUVA HOLOTYPE; ISOTYPES at BISH, K, MASS), collected Aug. 20, 1956, at Namara, Lambasa, Mathuata Province, Vanua Levu. The holotype of *P. lauensis* is *Kondo 1* (BISH), collected Oct. 28, 1968, at Matanasiwa, Vatoa. *Pandanus matukuensis* is typified by *Kondo*, Nov. 9, 1968 (BISH), obtained on Matuku without further locality. The type of *P. mbalawa* is *Smith 1164* (FI HOLOTYPE; many ISOTYPES), collected Feb. 23, 1934, among palms near coast on limestone formation, Fulanga. The type of *P. nandensis* is *DA 10288* (coll. D. Koroiveibau) (BISH HOLOTYPE; ISOTYPES at K, MASS, SUVA), collected July 25, 1956, along Namulomulo road, east of Nandi, Mba Province, Viti Levu. The holotype of *P. onoilauensis* is *Kondo*, Aug. 22, 1968 (BISH; ISOTYPE at K), obtained on Ono-i-Lau without further locality. *Pandanus ovalauensis* is typified by *DA 17085* (coll. J. W. Parham & D. Koroiveibau) (BISH HOLOTYPE; ISOTYPE at K), collected Oct. 2, 1969, near Wainiloka, Ovalau. The holotype of *P. pansus* is *Kondo*, Sept. 21, 1968 (BISH), from Totoya without further locality. *Pandanus parhamii* is based on *DA 9983* (coll. S. Nand & J. W. Parham) (BISH HOLOTYPE; ISOTYPES at K, MASS, SUVA), collected Feb. 15, 1956, along King's Road between Naimborembore and Naimasimasi, Tailevu Province, Viti Levu. The holotype of *P. patulior* is *DA 16865* (coll. Smith, J. W. Parham, Tomlinson, et al.) (BISH; ISOTYPE at SUVA), collected April 29, 1969, on beach at Wairuku Plantation, Thakaundrove Province, Vanua Levu. *Pandanus rhizophorensis* is typified by *DA 10057* (coll. D. Koroiveibau) (BISH HOLOTYPE; ISOTYPES at K, MASS, SUVA), collected Feb. 25, 1956, in mangrove swamp near Suva Cemetery, Suva, Rewa Province, Viti Levu. The type of *P. seruensis* is *DA 10096* (coll. J. W. Parham) (BISH HOLOTYPE; ISOTYPES at K, MASS, SUVA), collected March 28, 1956, in a swampy field near Namelimeli, Queen's Road, Namosi Province, Viti Levu. The holotype of *P. smithii* is *Smith 1377* (BISH; many ISOTYPES), collected March 22, 1934, in swamp in open place, Ndelaimoala, Moala. *Pandanus subhumerosus* is typified by *DA 10451* (coll. M. Miller) (BISH HOLOTYPE; ISOTYPES at K, MASS, SUVA), obtained Aug. 13, 1956, on Naitamba without further locality. The holotype of *P. vandra* is *Degener 15456* (fr.) (S; many ISOTYPES), collected May 28–June 17, 1941, near Vaileka, Vatundamusewa, vicinity of Rewasa, on grassy forehill, Ra Province, Viti Levu.

Differences among these many type specimens can certainly be observed, but they are of a nature that does not suggest the establishment of isolating mechanisms. A continuing interchange of genetic material is to be expected among populations such as those represented by the cited type collections, due to lack of geographic or ecological barriers and the obvious movement of buoyant phalanges from one island to another. No two specimens of this complex are identical, and the alternative to combining names under a single species is to describe dozens or hundreds of others, even in as restricted an area as Fiji. In selecting the epithet *pyriformis* for this Fijian population I have no confidence that it will be maintained in the future, since earlier epithets have been applied in other archipelagoes to populations of sect. *Pandanus* that seem essentially indistinguishable from the Fijian population here discussed.

DISTRIBUTION: In the sense here employed, *Pandanus pyriformis* is endemic to Fiji, where it may be expected in every suitable habitat below an elevation of about

400 m. To complete this record, I list all the collections, except the types already mentioned, that I have examined.

AVAILABLE COLLECTIONS: VITI LEVU: MBA: Vatia Point, *DA 10442*. SERUA: Flat coastal strip in vicinity of Ngaloa, *Smith 9338*; Waimate Beach, Navua, *DA 10120*. RA: Near Vaileka, Vatundamusewa, vicinity of Rewasa, *Degener 15456* (δ) (renumbered *15456a* by St. John); near Matawailevu, King's Road, *DA 10445*; Thamboni, *DA 9660*. TAILEVU: Matavatathou, *DA 9242* (*McKee 2809*), *DA 9964*. REWA: Suva, *Parks 20876* (δ) (renumbered *20876a* by St. John); Suva, Dept. Agriculture compound, *DA 10054*. VANUA LEVU: MATHUATA: Naliuninga, Seangangga, *DA 10483*; Lambasa, *Krauss 1340*. THAKAU-NDROVE: Wairuku Plantation, *DA 16866*. MOALA: Naroi, Kondo "M.A.", Dec. 4, 1968. TOTOYA: Sea level to summit, *Bryan 355*. NAITAMBA: *DA 10449*. VANUA MBALAVU: Near Lomaloma, *DA 10219*, *10246*. KAMBARA: On cliff, *Smith 1281*. ONO-I-LAU: Nukuni, *Krauss 1308*.

QUESTIONABLE SPECIES

Pandanus caricosus sensu Seem. in *Bonplandia* 9: 260. 1861, Viti, 444. 1862, Fl. Vit. 281. 1868; Horne, *A Year in Fiji*, 110, 265. 1881; Drake, Ill. Fl. Ins. Mar. Pac. 323. 1892; J. W. Parham, Pl. Fiji Isl. 283. 1964, ed. 2. 376. 1972; non Kurz.

The cited references to "*Pandanus caricosus*" are ultimately based on *Seemann 650* (K, sterile, with narrow leaves); according to Seemann he observed this plant, locally known as *voivoi* or *kiekie*, on Viti Levu and Ovalau. Reference of Seemann's concept to a Fijian species can be only a guess, but from his comments, including the fact that the best mats are made from the plant, he may have taken his material from a young specimen of *P. whitmeeanus*, *P. thurstonii*, or *P. joskei*.

Pandanus odoratissimus sensu Seem. in *Bonplandia* 9: 260. 1861, Viti, 444. 1862; Horne, *A Year in Fiji*, 110, 265. 1881; Drake, Ill. Fl. Ins. Mar. Pac. 324, p. p., quoad spec. vit. 1892; J. W. Parham, Pl. Fiji Isl. 283 (as var. *odoratissimus*). 1964, ed. 2. 376 (as var. *odoratissimus*). 1972; non L. f.

Pandanus verus sensu Seem. Fl. Vit. 281. 1868; non Kurz.

Pandanus tectorius sensu J. W. Parham in Agr. J. Dept. Agr. Fiji 29: 33. 1959.

The cited references are based on the plant known as *mbalawa* or *vandra*, said to be the common coastal species, from the leaves of which coarse mats are made. Seemann's references are to his no. 649 (not now located at either K or BM). One of the species of sect. *Pandanus* is obviously intended, since the common names are indiscriminately applied to all individual plants of that section in Fiji.

Pandanus virens Horne, *A Year in Fiji*, 265, nom. nud. 1881.

As this binomial is merely listed by Horne, without reference to a collection number or local name, I see no way to place it. Stone (in Proc. Biol. Soc. Wash. 80: 49. 1967) lists it as a synonym of *Pandanus thurstonii*, but I have found no Horne collection representing any species of the genus.

ORDER TYPHALES

FAMILY 43. TYPHACEAE

TYPHACEAE Juss. Gen. Pl. 25, as *Typhae*. 1789.

Monoecious, rhizomatous herbs of marshes and lakes; stems simple, submerged at base; leaves distichous, radical and cauline, linear, sheathing at base, aerenchymatous; inflorescence a dense, terminal spike; flowers anemophilous, protandrous, small, numerous, densely crowded on the spadix, the δ distal, the η proximal, those of the two sexes contiguous or remote, each group with a deciduous primary leaflike bract at base; stamens and ovaries mixed with slender, jointed, threadlike organs (bracts) and scales; δ flowers with 2-5 (-7) stamens, the filaments connate proxi-

mally, the anthers oblong-linear, basifixed, the connective produced; ♀ flowers crowded on very short lateral axes, these bearing subtending bracts composed of a hairlike proximal portion and an expanded lamina, each flower consisting of a hair-bearing axis (gynophore) and a fusiform ovary, this 1-locular, the ovule solitary, anatropous, pendulous, the style filiform, the stigma linear to spatulate-oblong; sterile flowers usually present; fruit a follicle, at length dehiscing, bearing the gynophore and its attached hairs; seeds fusiform, with farinaceous endosperm and a straight embryo.

DISTRIBUTION: One genus of about ten species, in the tropical and temperate regions of both hemispheres. A single species is indigenous in Fiji.

1. *TYPHA* L. Sp. Pl. 971. 1753; Seem. Fl. Vit. 280. 1868; Graebn. in Pflanzenr. 2 (IV. 8): 8. 1900; Briggs & Johnson in Contr. New South Wales Nat. Herb. 4: 63. 1968.

Characters and distribution of the family.

- LECTOTYPE SPECIES:** *Typha latifolia* L. (vide P. Wilson in N. Amer. Fl. 17: 3. 1909), one of Linnaeus's two original species.

USEFUL TREATMENT OF GENUS: Briggs, B.G., & L.A.S. Johnson. The status and relationships of the Australasian species of *Typha*. Contr. New South Wales Nat. Herb. 4: 57-69. 1968.

1. *Typha domingensis* Pers. Syn. Pl. 2: 532. 1807; Briggs & Johnson in Contr. New South Wales Nat. Herb. 4: 58, fig. 1a, 2a. 1968; A. C. Sm. in Allertonia 1: 349, fig. 5. 1978.

Typha angustifolia sensu Seem. in Bonplandia 9: 260. 1861, Viti, 443. 1862, Fl. Vit. 280. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 324. 1892; J. W. Parham in Dept. Agr. Fiji Bull. 35: 147. 1959, Pl. Fiji Isl. 268. 1964, ed. 2. 364. 1972; non L.

The infrequently collected *Typha* in Fiji occurs near sea level in swampy areas, in shallow water, and in tidal creeks, being nearly submerged at high tide. It is a coarse herb attaining a height of slightly over a meter.

TIPIFICATION: The type is a West Indian specimen from Santo Domingo (collector not specified). This was not seen by Briggs and Johnson in their review of the Australasian species, their conclusions having been based on the examination of abundant material including that from the West Indies.

DISTRIBUTION: Tropical and warm temperate regions of both hemispheres, occurring in the Old World from Africa, India, Malesia, and Australia eastward to Fiji and the Society Islands. At the time of their study in 1968, Briggs and Johnson had not examined material eastward of New Caledonia, but their work makes it plain that the species in Fiji and the Societies represents *Typha domingensis*. *Typha angustifolia* is a species of North Temperate regions. Collections of *Typha* have not been seen, but are to be expected, from the archipelagoes between Fiji and the Societies. In fact, W. R. Sykes (in litt.) informs me that he has seen sterile plants of *Typha* growing on the islands of Mangaia and Mitiero (Cook Islands); very likely these represent *T. domingensis*.

LOCAL NAMES: *Ndeniruve*; *ndenisonge*; *ndenisongge*; *bullrush*.

AVAILABLE COLLECTIONS: VITI LEVU: REWA: Lomanikoro, DA 780, 11545. MOTURIKI: Seemann 646. Seemann mentioned his collection as coming from Kandavu, but the K sheet is clearly indicated as from Moturiki; possibly he also observed the species on Kandavu.

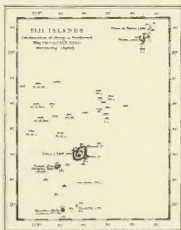


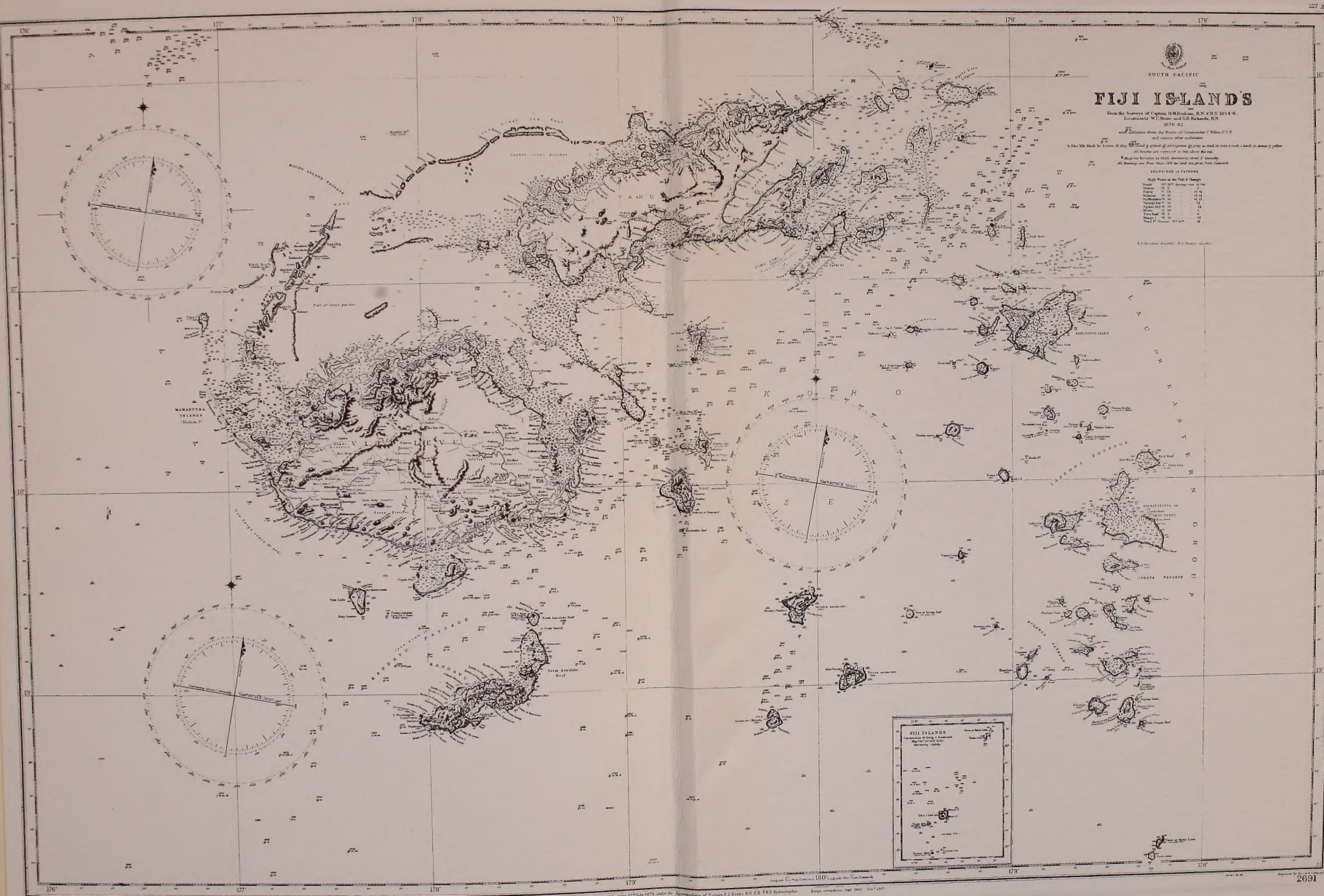


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Week 6	W 20	22	22
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Week 9	W 20	28	28
Week 10	W 30	35	35





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